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TWO CASES OF HAPLO-LETHAL DEFICIENCY IN USTILAGO BULLATA OPERATIVE AGAINST SAPROPHYTISM [1]

GEORGE W. FISCHER

(WITH 4 FIGURES)

The smut fungi have been considered as incompletely facultative saprophytes, since in the majority of cases the haploid mycelium and sporidia have been found to be the only stage of these organisms capable of a saprophytic existence, while the dikaryon mycelium is obligately parasitic. Ordinarily no difficulty is experienced in culturing the smut fungi, and the literature shows that many species have been successfully grown on artificial media, these cultures usually being represented by pedigreed haplonts of two or more sexes, depending upon the species concerned. However, during the course of extensive cultural studies of *Ustilago bullata* Berk.[2] the writer has encountered a phenomenon which apparently is unparalleled in the records of previous studies of the smut fungi.

[1] Grass disease investigations of the Division of Forage Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, in cooperation with the Soil Conservation Service, Section of Nurseries, and the Divisions of Plant Pathology and Agronomy of the Washington State College Agricultural Experiment Station.

[2] In this paper the binomial *Ustilago bullata* is used in the sense suggested by Fischer (**6**), to include *Ustilago bromivora* (Tul.) Fisch. von Waldh. and *U. Lorentziana* Thüm., long supposed to be confined to *Bromus* spp. and *Hordeum* spp. respectively.

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What appears to be the effect of lethal factors has been discovered in certain monosporidial isolates in culture.

During the winter of 1937–38, a number of collections of *Ustilago bullata* were obtained in pure culture as pedigreed monosporidial isolates. Of 28 collections, 26 behaved in a more or less normal manner when sporidia were isolated to secure cultures, so that pedigreed cultures of opposite sex were easily obtained. Two collections, however, collections N–H and N–I (see legend, Table 1) from *Elymus canadensis* L. and *E. sibiricus* L. respectively, presented a perplexing and troublesome phenomenon. The isolation of sporidia was easily accomplished, but when these were allowed to grow into monosporidial cultures it was noticed that approximately only half of these isolates would bud and develop into cultures in the normal manner. The remaining isolates would bud a few times and then gradually come to a complete standstill, from which they never resumed growth. Even when transferred to a new hanging drop or block of agar they usually underwent no further development. Occasionally a very few bud sporidia would be produced, after which the colony would fail to develop further, and would finally disintegrate.

Since the cultures were desired for use as inoculum, the phenomenon described above became particularly exasperating when it was discovered that all of the isolates which did develop into colonies were of the same sexual phase. When the cultures were mated with each other on plain agar (Bauch's test for sex (1) (2)) absolutely no reaction followed. There were neither sporidial fusions nor infection hyphae, both of which characterize the reactions of sporidia of opposite sex when mixed on plain agar.

In the hope of obtaining cultures of opposite sex of these two collections of *Ustilago bullata,* isolations were repeatedly attempted. Thirteen vigorous monosporidial cultures of N–H, and 6 of N–I were finally obtained, but when these were paired with each other in all combinations, both within and between collections, they all proved to be of the same sex.

During the winter of 1938–39 it again became desirable to obtain pedigreed monosporidial cultures of opposite sex of certain collections of *Ustilago bullata,*—(1) those collections of which cultures had been lost during the summer months, and (2) new collections

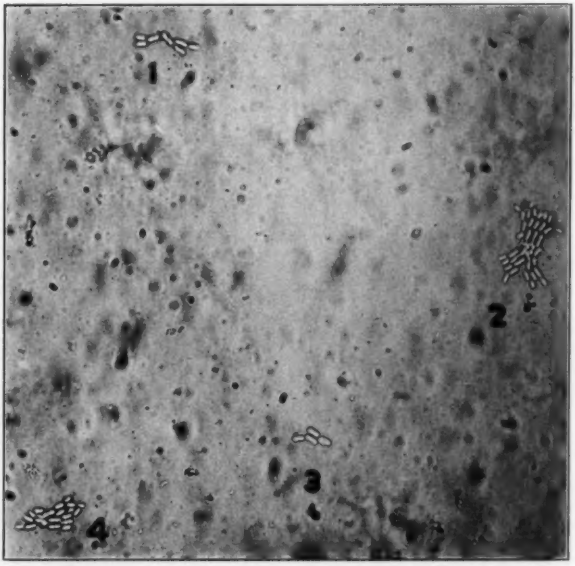

FIG. 1. Sex-linked lysis in *Ustilago bullata* (collection N–I from *Elymus canadensis*). Four monosporidial isolates from the same promycelium 24 hours after isolation on potato-dextrose agar. Note that numbers 1 and 3 seem to be much less vigorous than numbers 2 and 4. × about 300.

added during the 1938 season. This time three additional and new collections exhibited the same phenomenon as shown by collections N–H and N–I the year before. These are as follows:

Collection symbol	*Host*	*Locality*
N-A3	*Agropyron pauciflorum* (Schwein.) Hitchc.	Soil Conservation Nurseries, Pullman, Wn.
N-L	*Festuca idahoensis* Elmer.	Soil Conservation Nurseries, Pullman, Wn.
M-Y	*Bromus inermis* Leyss.	Bozeman, Mont. (collected by L. P. Reitz)

With these collections the same difficulty was experienced, as described above, for collections N–H and N–I from *Elymus* spp. Every time two, three, or four isolates were made from the same promycelium, approximately half would fail to develop beyond budding a few times, while the remaining cultures would develop into colonies with great rapidity. Even after 24 hours growth differ-

ences between the isolates could be detected as shown in figure 1. After 48 hours the difference was even more manifest (FIG. 2) and after 72 hours the isolates possessing the growth-inhibiting factor had usually ceased growth entirely (FIG. 3). After six or seven days the normal isolates would develop into large colonies, easily visible to the naked eye, while those possessing the deficiency had not developed much if any beyond what they had attained during the first two or three days (FIG. 4).

When this phenomenon was noticed in these collections (N–A3, N–H, N–I, N–L, M–Y) during 1938–39, the question presented itself as to whether, as with N–H and N–I in 1937–38, the isolates obtained of these collections would again prove to be all of the same sex. In order to give this possibility a fair test, several isolates were obtained from each collection (only 3 from N–H since it seemed that this collection had had a fair test the previous year), until, of the five collections 29 new pedigreed monosporidial isolates

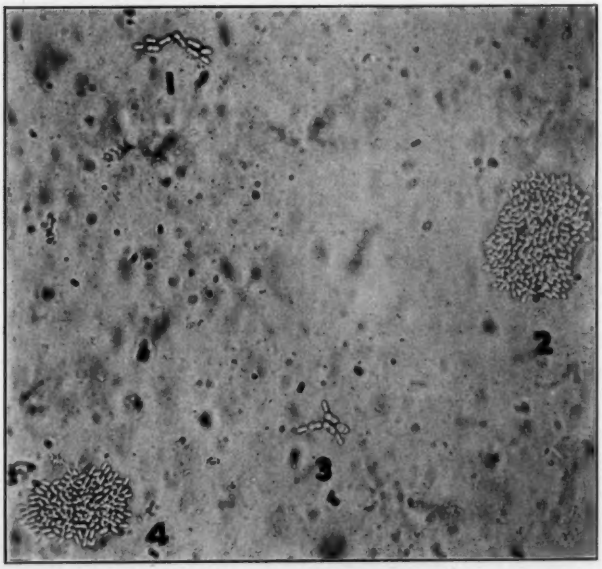

FIG. 2. Same isolates as in figure 1 but 48 hours after isolation. Numbers 1 and 3 have produced only two and three sporidia respectively. × about 300.

had been secured. These cultures were paired with each other, both within and between collections in all possible combinations, on plain 2 per cent agar. The results of these pairings are shown in Table 1. It is seen from a glance at this table that, of the 29 isolates, all but two (N–L 64 and 71) were of the same sex. Thus cultures N–L 64 and N–L 71 gave a strong reaction (as characterized by an abundance of fusions and subsequently-produced infection hyphae) with each of the 27 other cultures. Among these latter cultures, no reaction of any kind was observed.

Since sex in the smut fungi is only a relative matter, it appeared possible that the sex reactions of these 29 isolates of *Ustilago bullata* were valid only with reference to the five collections of this species showing the haplo-lethal deficiency. Accordingly, it seemed that a further check on the 29 isolates should be made by mating them with pedigreed monosporidial isolates of other collections of *U. bullata* not possessing the deficiency, and also with other available species. Twenty-two pedigreed monosporidial cultures representing *U. nigra* Tapke, *U. bullata, U. Hordei* (Pers.) Kellerm. & Swingle, *U. levis* (Kellerm. & Swingle) Magn., and *U. Avenae* (Pers.) Jens.[3] were paired against the 29 isolates of the collections of *U. bullata* exhibiting this growth-inhibiting factor. The results of these matings are summarized in Table 2.

The data presented in Table 2 show that the sex reaction of the 29 isolates of *Ustilago bullata* obtained when these were paired with each other is fully substantiated by the reaction obtained when the same cultures were paired with cultures of other species and with other collections of *U. bullata*. Thus, cultures N–L 64 and N–L 71 are of one sex, and the other 27 isolates are of another sex, not only with reference to each other, but also to isolates of other *Ustilago* spp., and of other collections of *U. bullata*.

Apparently, in collections N–A3, N–I, N–H, and M–Y this lethal factor is definitely sex-linked; otherwise at least a few of the 36 isolates (including 13 isolates of N–H studied in 1937–38) of these collections would have proven to be of opposite sex from the others. Since it is possible to determine positively after 24–36

[3] The writer is indebted to Wayne Bever and C. S. Holton, Division of Cereal Crops and Diseases, for chlamydospores of *Ustilago nigra*, and for pedigreed monosporidial cultures of *U. levis* and *U. Avenae*, respectively.

TABLE 1

REACTIONS OF 29 MONOSPORIDIAL ISOLATES OF *Ustilago bullata* (REPRESENTING THE COLLECTIONS N-A3, N-I, N-L, N-H, AND M-Y WHICH EXHIBIT A LETHAL CHARACTER INHIBITING A SAPROPHYTIC EXISTENCE) WHEN MATED WITH EACH OTHER, BOTH WITHIN AND BETWEEN COLLECTIONS

		N-A3					N-I								N-L						N-H			M-Y						
		82	101	111	121	132	81	91	92	101	111	113	121	131	53	64	71	81	111	121	111	121	131	71	82	91	102	112	121	132
N-A3	82	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
	101		−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
	111			−	−	−	−	−	−	−	−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
	121				−	−	−	−	−	−	−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
	132					−	−	−	−	−	−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
N-I	81						−	−	−	−	−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
	91							−	−	−	−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
	92								−	−	−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
	101									−	−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
	111										−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
	113											−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
	121												−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
	131													−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−

TABLE 1 (*Continued*)

		N-A3					N-I							N-L						N-H			M-Y						
		82	101	111	121	132	81	91	92	101	111	113	121	131	53	64	71	81	111	121	111	121	131	71	82	91	102	112	121	132
N-L	53														−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
	64															−	−	+	+	+	+	+	+	+	+	+	+	+	+	+
	71																−	+	+	+	+	+	+	+	+	+	+	+	+	+
	81																	−	−	−	−	−	−	−	−	−	−	−	−	−
	111																		−	−	−	−	−	−	−	−	−	−	−	−
	121																			−	−	−	−	−	−	−	−	−	−	−
N-H	111																				−	−	−	−	−	−	−	−	−	−
	121																					−	−	−	−	−	−	−	−	−
	131																						−	−	−	−	−	−	−	−
M-Y	71																							−	−	−	−	−	−	−
	82																								−	−	−	−	−	−
	91																									−	−	−	−	−
	102																										−	−	−	−
	112																											−	−	−
	121																												−	−
	132																													−

Legend: + = Numerous fusions and subsequent infection hyphae
− = No reaction
N-A3 = *Ustilago bullata* from *Agropyron pauciflorum*
N-I = " " " *Elymus sibiricus*
N-L = " " " *Festuca idahoensis*
N-H = " " " *Elymus canadensis*
M-Y = " " " *Bromus inermis*

TABLE 2

REACTIONS OF 29 MONOSPORIDIAL ISOLATES OF *Ustilago bullata* (REPRESENTING THE COLLECTIONS N-A3, N-I, N-L, N-H, M-Y WHICH EXHIBIT A LETHAL CHARACTER INHIBITING A SAPROPHYTIC EXISTENCE), WITH *U. nigra*, *U. bullata*, *U. Hordei*, *U. levis* AND *U. Avenae*

		K-A		N-F				E-D				N-E		M-J		U.l.				U.a.			
		113	114	91	92	93	94	51	52	53	54	71	73	72	73	911	912	913	914	531	532	533	534
N-A3	82	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	101	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	111	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	121	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	132	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
N-I	81	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	91	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	92	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	101	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	111	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	113	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	121	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	131	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
N-L	53	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	64	−	+	+	−	+	−	+	−	+	−	+	−	+	−	+	−	−	+	+	−	+	−
	71	−	+	+	−	+	−	+	−	+	−	+	−	+	−	+	−	−	+	+	−	+	−
	81	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	111	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	121	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+

TABLE 2 (*Continued*)

		K-A		N-F				E-D				N-E		M-J		U.l.				U.a.			
		113	114	91	92	93	94	51	52	53	54	71	73	72	73	911	912	913	914	531	532	533	534
N-H	111	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	121	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	131	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
M-Y	71	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	82	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	91	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	102	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	112	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	121	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+
	132	+	−	−	+	−	+	−	+	−	+	−	+	−	+	−	+	+	−	−	+	−	+

Legend: + = sporidial fusions in abundance and subsequent infection hyphae
− = no reaction
K-A = *Ustilago nigra*, from cultivated barley
E-D = " *Hordei*, " " "
U.l. = " *levis*, " " oats
U.a. = " *Avenae*, " " "
N-F = " *bullata*, " *Elymus sibiricus*
N-E = " " " *Agropyron inerme*
M-J = " " " *Bromus squarrosus*
N-A3 = " " " *Agropyron pauciflorum*
N-I = " " " *Elymus sibiricus*
N-L = " " " *Festuca idahoensis*
N-H = " " " *Elymus canadensis*
M-Y = " " " *Bromus inermis*

hours which isolates will and which will not continue development, a further check on the sex-linkage of this lethal character was made by transferring a few sporidia from both types of isolates to hanging drops of plain agar and mixing them, by means of a Chambers micro-manipulator. This was done with each collection, excepting N–L. In each case, infection hyphae resulted from such matings, although the fused sporidia could not be definitely discerned. Further proof is thus indicated that the sporidia which are incapable of developing into colonies are of one sexual phase, and the other sporidia, which can be cultured, are of the other phase.

In the case of collection N–L, in which the lethal appears not to be sex-linked, further study seemed desirable to determine if, in isolates N–L 64 and N–L 71, the factor somehow happened to segregate independently of the factor for sex, or if such independence of segregation is the rule. Accordingly from 13 promycelia 30 sporidia were isolated and their subsequent development watched. The history of these isolates is given in Table 3.

TABLE 3

HISTORY OF THE BEHAVIOR OF 30 PEDIGREED MONOSPORIDIAL ISOLATES OF COLLECTION N-L OF *Ustilago bullata* ON MALT AGAR

Promycelium No.	Sporidia isolated: Pedigree Nos.	Sporidia with lethal factor: Pedigree Nos.	Sporidia developing into colonies: Pedigree Nos.	Sex distribution	
				+	−
13	1, 2, 3	1	2, 3	2	3
14	1, 2, 3	2	1, 3		1, 3
15	1, 2	2	1	1	
16	1, 2, 3	1, 3	1	1	
17	1, 2, 3		1, 2, 3	1, 3	2
18	1, 2	1, 2			
19	1, 2	2	1	1	
20	1, 2	1, 2			
21	1, 2	1	2		2
22	1, 2		1, 2	2	1
23	1, 2		1, 2	1, 2	
24	1, 2	2	1	1	
25	1, 2	1, 2			
Totals	30	14	16	10	6

As seen in Table 3, of the 30 sporidia isolated, again approximately half possessed a haplo-lethal deficiency. Sixteen budded

rapidly into normal sporidial colonies, while 14 failed to develop beyond the production of a few bud sporidia. When the 16 normal isolates were paired with each other in all combinations it was found that both sexes were represented; 10 were of one sex and 6 of the other. These results are regarded as further proof that the haplo-lethal exhibited in collection N–L of *Ustilago bullata*, from *Festuca idahoensis*, is definitely not sex-linked.

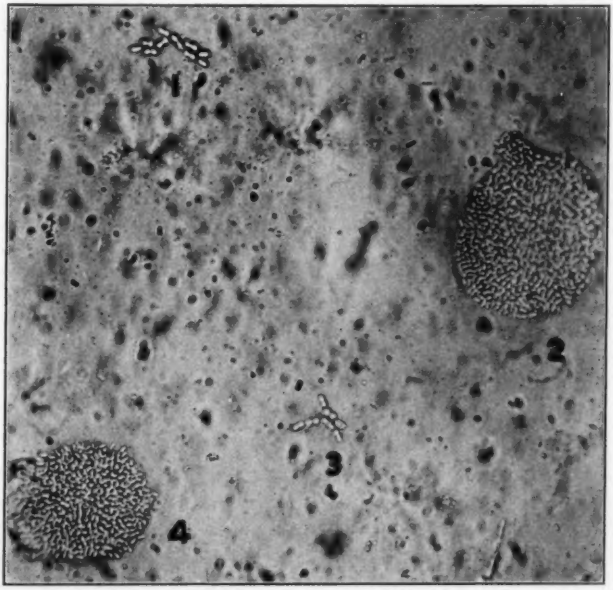

FIG. 3. Same isolates as in figures 1 and 2 but 72 hours after isolation. Numbers 1 and 3 have almost ceased growth entirely at 10 and 7 sporidia respectively, while numbers 2 and 4 each consist of hundreds of sporidia. × about 300.

Considering that collections N–A3, N–H, N–I, and M–Y do possess a sex-linked haplo-lethal deficiency, the question arose as to whether the factor is operative in nature under field conditions. If one sex is entirely repressed, even in nature, it would be difficult to understand how infection could take place, considering that both sexes are necessary to infection.[4] Chlamydospore material of col-

[4] The writer's unpublished data.

lections N–A3, N–I, and M–Y being of sufficient quantity to provide inoculum, a number of grasses were inoculated with these, seeded in the greenhouse and transplanted to the field in the spring of 1939. The results of these inoculations will be reported in detail elsewhere. It is sufficient to record here that no infection was obtained with N–A3, but high percentages of infection resulted on a number of grasses in the case of collections N–I and M–Y. It is thought the few grasses used for collection N–A3 did not include a susceptible host. At least in the case of collections N–I and M–Y the lethal factor did not operate against infection.

DISCUSSION

Lysis in the smut fungi, thought to be due to lethal factors, has been reported before, but apparently only in germinating F1 chlamydospores. Chilton (**4**) and Laskaris (**7**) reported the occurrence of such lysis in F1 spores of only certain combinations of monosporidial lines of *Ustilago Zeae* (Beckm.) Unger and of *Sphacelotheca Sorghi* (Link) Clint., respectively, and the phenomenon was thought to be due to a lethal factor or factors. In these cases, however, the lysis reported must have been of an entirely different nature from that reported in the present paper in that the lethal factor apparently was not operative against the saprophytic development of the haplonts, else they could not have been cultured to provide the monosporidial lines which were combined to make the crosses. The cases of lysis in the smut fungi reported by previous investigators have been represented by the abnormal germination of the chlamydospores and subsequent death of their promycelia.

Although zygotic and sporophytic lethals are common in both plants and animals, gametic and gametophytic lethals apparently are rare. Dodge (**5**) reported a lethal agent in cultures of *Neurospora tetrasperma*. In crosses where one of the parents possessed the lethal, half of the uninucleate f1, f2 or f3 ascospores would die after undergoing slight germination. The remaining ascospores produced mycelia of normal growth, and represented both sexes. The lethal was not, therefore, sex-linked and corresponds to the lethal exhibited in collection N–L of *Ustilago bullata* described above. Wettstein (**8**) recorded an instance of the operation of a

lethal in certain F1 interspecific moss hybrids where two spores of a tetrad gave rise to plants similar to the female parent, while the other two failed to develop further. Here it can only be assumed that the two lethal spores represented the male gametophytes, in which case the lethal was sex-linked. This situation would be homologous to the sex-linked lethal described herein for *U. bullata*, since the four tetraspores correspond to the four sporidia typically produced on the promycelium of many *Ustilago* spp.

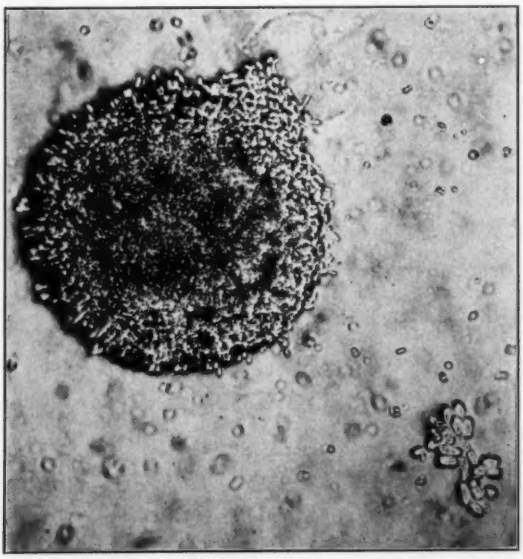

FIG. 4. Sex-linked lysis in *Ustilago bullata* (collection N–A3 from *Agropyron pauciflorum*). Development of two monosporidial isolates from the same promycelium six days after isolation on potato-dextrose agar. One isolate consists of thousands of bud sporidia, whereas the other consists of approximately only 25 sporidia. × about 450.

Lethals of pollen-tube development in F1 progeny from radium-treated parents in *Datura* have been described by Buchholz and Blakeslee (3). One lethal expressed itself in two ways: (1) Failure of half of the pollen grains to germinate. (2) Early bursting of half the pollen tubes. Here is a case, then, of a gametophytic lethal in the seed plants. Other cases have been reported.

These other instances of gametic or gametophytic lethals do not help much in explaining the present cases of haplo-lethal deficiency in *Ustilago bullata*.[5] The writer's material had not had radium or x-ray treatment, nor was it of hybrid origin (unless representing natural hybrids which is, of course, possible). Obviously more detailed study of the genetics of these collections of *U. bullata* possessing the lethals is necessary to a more complete explanation of their expression. At present it would seem that in one instance (collection N–L) the lethal is probably borne on an odd chromosome and is independent of the factor or factors for sex. In the other four instances it seems definite that the lethal factor is somehow linked with the factor governing sex.

In conclusion it should be pointed out that possibly the haplo-lethal deficiencies described herein for certain collections of *Ustilago bullata* should be considered as only "semi-lethal" inasmuch as they seem to operate only against saprophytic growth and do not interfere with the normal function of paired nuclei in initiating the parasitic dikaryophase.

SUMMARY

Five collections of *Ustilago bullata* on *Agropyron, Bromus, Elymus,* and *Festuca* spp. were found to possess a haplo-lethal deficiency preventing saprophytic development. Approximately half of the sporidia isolated from any promycelium would develop, when isolated, into typical sporidial colonies. The other sporidia would bud several times and then gradually undergo complete lysis.

In four of the five collections this lethal appears to be definitely sex-linked. Forty-two pedigreed monosporidial isolates of these four collections proved to be all of the same sex phase. The fifth collection possesses a lethal which is segregated independently of sex factors, since both sexes were represented in the isolates not possessing the character.

Twenty-nine pedigreed monosporidial isolates of the five collections exhibiting the lethal were paired with 22 such isolates from

[5] Since submitting this paper for publication a recent contribution by Winge and Laustsen (*Saccharomycodes Ludwigii* Hansen, a balanced heterozygote. Compt. Rend. Lab. Carlsberg Ser. Phys. **22**: 357–370. 1939.) has come to the writer's attention. These authors describe a phenomenon in a yeast fungus quite comparable to the lethals here described for *Ustilago bullata*.

Ustilago nigra, U. Hordei, U. levis, U. Avenae and of collections of *U. bullata* not possessing it. Both sexes were equally represented in these 22 isolates, and when paired with these, the 29 isolates from collections exhibiting the character gave the same reaction as when paired with each other. Thus, in the four collections in which the lethal factor is sex-linked, the 23 isolates representing these collections were all of the same sex, not only with reference to each other, but with reference to the 22 isolates of other collections and other species.

These haplo-lethal deficiencies operate only against saprophytic development. When chlamydospores of two of the collections were used as inoculum high percentages of infection were easily obtained, showing that both sexes operate toward parasitic development, since both are necessary to infection.

Since the lethals are exhibited by approximately half of the sporidia borne on any promycelium, it is considered that they are probably borne on odd chromosomes, in one case sex-linked and in the other independent of sex.

AGRICULTURAL EXPERIMENT STATION,
PULLMAN, WASHINGTON

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THE RUSTS OF MINAS GERAES, BRAZIL

BASED ON COLLECTIONS BY A. S. MÜLLER[1]

H. W. THURSTON, JR.

The following is a report on the identification of the rusts collected in Minas Geraes, Brazil, by A. S. Müller formerly of the Escola Superior de Agricultura at Vicosa.

Professor Müller was from 1928–1937 an ardent collector of fungi in this region. His Brazilian specimens, numbering about 1200, are all deposited in the Herbarium of Cornell University at Ithaca, New York. Among them there are 210 collections of rusts. While many of these represent common and well known species, it is of interest to record many comparatively rare forms and six new to science. The present list records 108 species.

The Holway collections of South American rusts, made 1919–1922, probably represent the most extensive previous collections from this region. Arthur (Proc. Am. Phil. Soc. **64**. 1925) reports that 81 of the Holway specimens were secured in Minas Geraes. These as studied in part by Arthur and later completed by Jackson yielded 50 species from this Brazilian state. About half of these have been duplicated in the Müller collections.

Without any attempt to make a complete search of the literature for reports of other rusts in Minas Geraes, we have on the basis of these two lists approximately 130 species known from this region. Without doubt, this figure represents a very incomplete picture of the rust flora of so large and varied an area. It should be pointed out however, that only through long continued accumulation of such information as is here presented, can we hope to arrive at a fuller understanding of the factors that determine the distribution and ecology of parasitic fungi.

The writer wishes to acknowledge his indebtedness to Doctor F. D. Kern who has aided him generously with many determina-

[1] Contribution from the Department of Botany, The Pennsylvania State College, no. 127.

tions. The help of many colleagues who have responded promptly to calls for aid, especially in determination of the hosts, is also gratefully acknowledged.

AECIDIUM BRASILIENSE Dietel, Hedwigia **36**: 35. 1897.
On *Cordia ecalyculata* Vell., Vicosa (Teixeras), Oct. 26, 1934, *854*.

AECIDIUM CIRCINATUM Wint. Hedwigia **23**: 168. 1884.
On *Bignoniaceae* indet. possibly *Stenolobium* sp., Maria da Fi, Dec. 29, 1930, *226*.

Of the several aecia described on Bignoniaceae, this species with the walls of the aeciospores thicker above appears to be quite distinct. While we have had no opportunity to compare our specimen with the type it is placed here with considerable confidence.

AECIDIUM LINDAVIANUM Sydow, Monog. Ured. **4**: 129. 1923.
On *Cordia* aff. *alba* (Jacq.) R. & S., Vicosa, Nov. 14, 1929, *20*.

The type of this species which was described from Peru has not been available, but it seems to be distinct from other aecia on *Cordia*, the spores being quite small, 15–16 × 18–21 μ. This constitutes the first report of the species for Brazil.

Aecidium Mabeae sp. nov.

Pycnidiis epiphyllis, paucis, in greges parvos usque 1 mm. diam. aggregatis, conspicuis, dein nigrescentibus, subepidermicis, globosis, 80–100 μ diam.

Aecidiis hypophyllis, in maculis decoloratis 2–5 mm. diam. dispositis, cupulatis, profunde insidentibus, 0.1–0.2 mm. diam.; peridio albido, margine erecto; cellulis peridialibus rhomboideis, 26–32 μ longis, subimbricatis, pariete exteriore levi, ca. 3 μ cr. interiore 4–6 μ, striato, valde tuberculato-verrucoso; aecidiosporis late ellipsoideis vel oblongis, 20–26 × 27–35 μ; tunica hyalina, 1.5–2 μ, plerumque ad apicem incrassata, 5–7 μ, promimenter verrucosa.

On *Mabea brasiliensis* Muel.-Arg., Vicosa, April 1, 1933, *438*.

Of the numerous aecia on the family Euphorbiaceae there appears to be only one, *Aecidium Maprouneae* P. Henn. with spores thicker above. Our specimen on *Mabea* has spores thicker above, but not so thick as has been described for *A. Maprouneae*. In addition the aeciospores of our specimen are different in shape,

being less oblong. We have had no specimen of *A. Maprouneae* for comparison, but believe that the rust on *Mabea* is distinct.

Aecidium Mülleri sp. nov.

Pycniis epiphyllis, numerosis, in greges 2–7 mm. diam., in maculis decoloratis collectis, dein nigrescentibus, subepidermicis, non profunde insidentibus, conicis, magnis, 200–250 μ latis, 100–130 μ altis; paraphysibus incognitis.

Aecidiis hypophyllis, plus minusve in greges 3–8 mm. diam. in maculis decoloratis circinatim dispositis, cylindraceis, 0.2–0.3 mm. diam., peridio albido, margine eroso, plus minusve erecto; cellulis peridialibus rhomboideis, 28–32 μ longis, subimbricatis, pariete exteriore leve, 3–4 μ cr., interiore 5–6 μ, tuberculato-verrucoso; aecidiosporis late ellipsoideis, 13–16 × 16–23 μ; tunica hyalina, tenui, ca. 1 μ cr., subtillissime verrucosa.

On *Nectandra amara* Nees., Vicosa, Dec. 3, 1929, *39*.

This *Aecidium* is quite distinct from *A. Nectandrae* Jackson & Holway, which has larger spores that are thickened at the apex.

AECIDIUM TOURNEFORTIAE P. Henn. Hedwigia **34**: 338. 1895.
On *Tournefortia* sp., Vicosa, Aug. 30, 1934, *846*.

AECIDIUM XANTHOXYLINUM Speg. Rev. Argent. Hist. Nat. Buenos Aires **1**: 400. 1891.
On *Xanthoxylum* sp., Vicosa, May 2, 1931, *265*.
Dictyoloma peruviana Planch., Vicosa, Feb. 17, 1934, *729*.

These specimens are referred to this species without any authentic material for comparison. This rust has not been reported before on *Dictyoloma* which is closely related to *Xanthoxylum*. Both are genera of the family Rutaceae. The small spores 16–22 μ which appear smooth, seem to be quite distinct from any other rust on the order *Rutales*, though similar except for size to *A. Xanthoxyli* Peck, which is known in North America.

BITZEA INGAE (Sydow) Mains, Mycologia **31**: 38. 1939.
Maravalia Ingae Sydow, Mycologia **17**: 257. 1925.
Ravenelia Ingae (P. Henn.) Arth. N. Am. Flora **7**: 132. 1907.
On *Inga edulis* Mart., Uberaba, May 19, 1936, *1072*.
Inga sp., Vicosa, Jan. 20, 1935, *878*.

The name proposed by Mains is being used for this species. For a complete account of the synonomy involved, see his account (Mycologia **31**: 33–42. 1939).

CEROTELIUM DESMIUM (Berk. & Br.) Arth. N. Am. Flora **7**: 698, 1925.

On *Gossypium brasiliense* Macfad., Vicosa, Feb. 19, 1930, *134*. *Gossypium* sp., Bello Horizonte, July 14, 1935, *954*.

CEROTELIUM FICI (Cast.) Arth. Bull. Torrey Club **44**: 509. 1917.

On *Ficus carica* L., Vicosa, Oct. 13, 1929, *52*.

CEROTELIUM MALVICOLUM (Speg.) Diet. in E. & P. Nat. Pfl. II, **6**: 57. 1928.

On *Pavonia spinifer* Cav., Vicosa, May 25, 1934, II & III, *804*.

COLEOSPORIUM ELEPHANTOPODIS (Schw.) Thüm. Myc. Univ. *953*. 1878.

On *Elephantopus mollis* HBK., Vicosa, Nov. 14, 1929, *22*; June 3, 1933, *563*.

COLEOSPORIUM IPOMOEAE (Schw.) Burr. Bull. Ill. Lab. Nat. Hist. **2**: 217. 1885.

On *Ipomoea cairica* Sweet, Ouro Preto, Dec. 29, 1929, *79*.

DESMELLA ANEIMIAE (P. Henn.) Sydow, Ann. Myc. **16**: 241. 1918.

On *Anemia* sp., Vicosa, June 3, 1933, *566*.

DIDYMOPSORA SOLANI-ARGENTEI (P. Henn.) Dietel, Hedwigia **38**: 254. 1899.

On *Solanum Swartzianum* R. & S., Vicosa, April 1, 1933, *445*.

Known only from Brazil.

Endophylloides Degueliae sp. nov.

Pycnidiis non visis.

Teleutosoris hypophyllis, in maculis hypertrophicis 3–20 mm. diam. aggregatis, profunde insidentibus, peridio non visibili; sporas in columnas, siccas corneas protrudentibus; columnis 0.3–0.4 mm. diam. × 0.4–0.6 mm.; teleutosporis catenulatis, angulato-ellipsoidiis 18–21 × 26–36 μ, tunica hyalina, 2–3 μ cr. ad apicem incrassata usque 7 μ, subtillisime verrucosa.

On *Deguelia furfuracea* (St. Hil.) Benth. & Hook. Uberlandia, May 18, 1936, *1065*.

This rust has certain superficial characters like an aecidium. The absence of a peridium together with the fact that the spores form quite definite waxy or horny columns do not indicate its relationship with the form genus *Aecidium*. There are very definite characteristics of the genus *Endophylloides* as set up by Whetzel & Olive. To make the reference to this genus unquestionable it should be known how the spores germinate. While this is not known the structural characters, on which we usually rely, seem sufficient to warrant reference to this genus.

KEUHNEOLA LOESNERIANA (P. Henn.) Jackson & Holway, Mycologia **23**: 105. 1931.

On *Rubus* sp. Vicosa, Mar. 24, 1933, *420*; Feb. 4, 1934, *688*.

PHAKOPSORA CROTALARIAE (Dietel) Arth. Bull. Torrey Club **44**: 509. 1917.

On *Crotalaria stricta* (DC.), Vicosa, April 2, 1936, *1044*.

PHAKOPSORA CROTONICOLA (P. Henn.) K.T.W. Monog. Univ. Puerto Rico Series B, No. 2: 271. 1934.

Phakopsora argentinensis Arth. 1917.

On *Croton* cf. *compressus* Lam., Vicosa, July 3, 1933, *568*.

This specimen bears uredinia only. The spores seem a trifle large for this species but are occasionally thickened above. We are following Jackson (Mycologia **23**: 465) and Kern, Thurston and Whetzel (Monog. Univ. Puerto Rico Series B, No. 2: 271. 1934) in considering this species distinct from *P. Crotonis* (Cooke) Arth.

PHRAGMIDIUM DISCIFLORUM (Tode) James. Contr. U. S. Nat. Herb. **3**: 276. 1895.

On *Rosa* (Vich's Caprice), Vicosa, Aug. 27, 1934, *834*.

Müller's specimen no. *33*, collected in 1929 also at Vicosa, is undoubtedly the same species although no telia were present, making the identification less certain.

PROSPODIUM IMPOLITUM Jackson & Holway, Mycologia **24**: 90. 1932.

On *Bignoniaceae* (undet.), II & III, Vicosa, July 2, 1934, *810*.

It is to be regretted that a more specific host identification is impossible. All previous localities for the species are in Sao Paulo, Brazil.

PROSPODIUM TECOMICOLA (Speg.) Jackson & Holway, Mycologia **24**: 94. 1932.

On *Tecoma* sp., Lavras, *J. Deslandes 986*.

This species has been reported from Sao Paulo, Brazil, by Jackson (Mycologia **24**: 94. 1932). Dr. G. B. Cummins has suggested in a letter that *Prospodium concinnum* described from Venezuela by Sydow is probably identical.

PROSPODIUM TUBERCULATUM (Speg.) Arth. N. Am. Flora **7**: 161. 1912.

On *Lantana camara*, var. *aculeata* (L.) Moldenke, II, Ita, Aug. 23, 1932, *361*.

Lantana camara L. II, Vicosa, Feb. 17, 1934, *742*.

Prospodium Wulffiae sp. nov.

Uredosoris non visis; uredosporis teleutosoris immixtis, late ellipsoideis vel globosis, 19–20 × 21–26 μ; tunica pallida brunneo-flavida, 1.5 μ cr., moderate echinulata; poris 2, aequatorialibus.

Teleutosoris hypophyllis, sparsis vel gregariis, minutis, rotundatis, ca 1 mm. cr., mox nudis, pulverulentis, cacao-bruneis, epidermide rupta visibili; paraphysibus soro circumdantibus, incurvatis, altitudini sorae aequante, tunica dilutissime bruneola, leve; teleutosporis late ellipsoideis, 22–26 × 32–39 μ, supra et infra rotundatis; tunica obscure castaneo-brunnea, laminata, 2.5–3.5 μ cr., lamina exteriore gelatinosa non conspicua, prominenter papillis conicis verrucosa, ad apicem incrassata usque 6–7 μ, poro cellulae superioris apicale, inferioris basali, super poros in umbonem pallidiorem incrassata; pedicello hyalino, sporis breviore, infra singulo orbi appendiculato.

On *Wulffia maculata* (Ker.) DC., Vicosa, April 12, 1933, *456*.

It is not easy to decide whether this species should be referred to *Puccinia* or to *Prospodium*. The characters of the teliospores such as the laminate walls, the pores, and the appendages on the

pedicels are typical for *Prospodium*. There are incurved paraphyses and the urediniospore markings and pores agree also with *Prospodium*. Thus far *Prospodium* has been reported on *Bignoniaceae* and *Verbenaceae* with a single exception of a species on *Sapindaceae*. This host is a *Composite* but it would seem that the structural characters warrant placing the species in the genus *Prospodium*.

PUCCINIA ACANTHOSPERMI P. Henn. Hedwigia **41**: 296. 1902.
On *Acanthospermum australe* (Loefl.) Kuntze, Vicosa, Dec. 23, 1933, *667*.

Originally described on *A. xanthioides* from Venezuela, this species has been reported previously from Rio de Janeiro and São Paulo in Brazil.

PUCCINIA ALLII (DC.) Rud. Linnaea **1**: 392. 1829.
On *Allium sativum* L., Vicosa, II & III, Aug. 8, 1935, *983*.

The compact telial sori with numerous paraphyses have led to the use of the name, *P. Allii* although some taxonomists have considered this species to be a synonym of *P. Porri* (Sow.) Wint.

I have seen no report of either species from South America.

PUCCINIA AUGUSTATOIDES R. E. Stone, Bull. Torrey Club **36**: 549. 1909.
On *Rynchospora* sp., Vicosa, Feb. 6, 1930, *120*.

This specimen bears telia as well as uredinia which places the collection with considerable certainty as *P. augustatoides*. Previous collections consisting of uredinia only have usually been referred to *Uromyces Rhyncosporae* Ellis. (See Jackson, Mycologia **18**: 147. 1926.)

PUCCINIA ARECHAVELATAE Speg. Anal. Soc. Ci. Argent. **12**: 67. 1881.
On *Cardiospermum grandiflorum* Sw., Ana Florencia, July 21, 1933, *631*.
Cardiospermum Halicacabum L., Vicosa, April 24, 1930, *167*.
Serjania sp., Vicosa, Feb. 16, 1930, *129*; Dec. 14, 1933, *652*;

Sagoa Santa, July 16, 1935, *960*; Curvello, Mar. 1, 1936, *1007*.

PUCCINIA ATRA Dietel & Holway; Holway, Bot. Gaz. **24**: 29. 1897.
On *Valota insularis* (L.) Chase., Vicosa, Dec. 30, 1929, *82*.

PUCCINIA BAMBUSARUM (P. Henn.) Arth. Bot. Gaz. **65**: 467. 1918.
On *Olyra micrantha* H.B.K., Vicosa, Dec. **7**, 1933, *645*.

PUCCINIA CAMELIAE (Mayor) Arth. Mycologia **7**: 227. 1915.
On *Setaria scandens* Schrad., Vicosa, Mar. 30, 1933, *433*.

PUCCINIA CANNAE (Wint.) P. Henn. Hedwigia **41**: 105. 1902.
On *Canna* sp., II, Vicosa, Mar. 20, 1932, *321*.
Canna indica, Vicosa, Feb. 18, 1935, *872*.

PUCCINIA CAPSICI Mayor, Mém. Soc. Neuch. Sci. Nat. **5**: 501. 1913.
On *Capsicum* sp., Vicosa, Nov. 14, 1930, *230*.

The small teliospores of this specimen agree very well with *Puccinia Capsici*. Dr. H. L. Mason, of the University of California, has examined the specimen and writes that the host is probably an undescribed species of *Capsicum*.

PUCCINIA CENCHRI Dietel & Holway, Bot. Gaz. **24**: 28. 1897.
On *Cenchrus echinatus* L., Uberlandia, May 18, 1936, *1066*.
Cenchrus sp., Rio Brancho, July 31, 1934, II & III, *827*.

PUCCINIA CRASSIPES Berk. & Curt.; Berk. Grevillea **3**: 54. 1874.
On *Ipomoea* sp., Vicosa, June 12, 1931, I & III, *274*; April 16, 1933, I & III, *461*.

Specimen *274* bears abundant telia which are considered rare in this species. Mains (Carnegie Inst. Wash. Pub. 461, 102. 1935) suggests that the aecia may be repeating aecia. We can confirm his observations concerning the absence of pycnia.

PUCCINIA CYNODONTIS Lacroix, in Desmaz. Pl. Crypt. II *655*. 1859.
On *Capriola Dactylon* (L.) Kuntze, Vicosa, May 15, 1930, *175*.

PUCCINIA ELONGATA Speg. Anal. Soc. Ci. Argent. **9**: 168. 1880.
Aecidium Verbenae Speg. Anal. Soc. Ci. Argent. **9**: 174. 1880.
On *Verbena brasiliense* Vell., I, III, Vicosa, July 6, 1935, *944*; I only, Vicosa, Oct. 4, 1929, *1*.

That *Puccinia elongata* and *Aecidium Verbenae* are stages of one and the same fungus seems indisputable from a study of Müller's specimen *944*, which bears abundant telia arising within and around the aecia. The telia are compact and by themselves might certainly suggest a short cycled species. Our study indicates, however, that Spegazzini's early surmise as to the identity of these two forms was correct. The aecial stage has been the one most frequently collected. Pycnia are lacking and the suggestion is offered that the aecia may be repeating aecia. This species would seem to present a parallel case to that of *P. crassipes* noted above.

PUCCINIA EUPATORII Dietel, Hedwigia **36**: 32. 1897.
On Eupatorium squalidum DC., II & III, Lagoa Santa, July 16, 1935, *957*.
Eupatorium sp., Vicosa, Nov. 2, 1935, *997*.

No. *997* bears uredinia only but seems without doubt to belong here.

PUCCINIA EVADENS Hark. Bull. Calif. Acad. **1**: 34. 1884.
On *Baccharis* sp., Vicosa, June 3, 1933, *564*.

Jackson (Mycologia **24**: 143. 1932) has suggested that there is some doubt as to the specific limits of *P. evadens*. Our specimen agrees well with Holway's specimens from Minas Geraes which have been referred to this species.

PUCCINIA FLACCIDA Berk. & Br. Jour. Linn. Soc. **14**: 91. 1873.
On Echinochloa Crus-galli Beauv., Bello Horizonte, Dec. 23, 1929, *78*; II & III, Vicosa, April 4, 1930, *163*.

PUCCINIA GNAPHALII (Speg.) P. Henn. Hedwigia Beibl. **41**: 66. 1902.

On *Gnaphalium purpureum* L., Vicosa, June 20, 1933, II, *621*.

PUCCINIA GOUANIAE Holway, Ann. Myc. **3**: 21. 1905.

On *Gouania polygama* (Jacq.) Urban., Vicosa, June 5, 1933, II, *600*.

Known in South America only from Brazil and Colombia.

PUCCINIA GRAMINIS Pers. Neues Mag. Bot. **1**: 119. 1794.

On *Triticum aestivum* L., Vicosa, Dec. 12, 1933, *648*; Bello Horizonte, Oct. 14, 1936, *1106*.

PUCCINIA HENNINGSII Dietel, Hedwigia **36**: 31. 1897.

On *Baccharis genistelloides* (Lam.) Pers. Vicosa, Dec. 30, 1933, *670*.

Heterothalamus brunioides Less., Vicosa, Feb. 15, 1934, *720*.

The collection on *Heterothalamus* is placed here where it fits very well. It is obviously not *P. Heterothalami* Jackson & Holway, the only rust described on the genus *Heterothalamus*, the teliospores being colorless and not thickened above.

PUCCINIA HETEROSPORA Berk. & Curt. Jour. Linn. Soc. **10**: 356. 1869.

On *Paritium tiliaceum* (L.) Juss., Belo Horizonte, Jan. 27, 1934, *685*.

Sida spinosa L., Corintho, Mar. 2, 1936, *1006*.

Sida urens L., Vicosa, April 29, 1933, *512*.

Wissadula spicata Presl., Cataquazes, Jan. 25, 1935, *876*.

Paritium has not been recorded before as a host for this species, which is common on many genera of the Malvaceae.

PUCCINIA INSUETA Wint. Hedwigia **26**: 27. 1887.

On *Stigmaphyllon* sp., Vicosa, May 2, 1931, II, *266*; Feb. 18, 1934, II & III, *753*; July 25, 1934, II & III, *822*.

From available records this rust appears to be common in Brazil.

PUCCINIA JUSSIAEAE Speg. Anal. Soc. Ci. Argent. **12**: 68. 1881.
On *Jussiaea leptocarpa* Nutt., Vicosa, June 10, 1933, *617*.

Originally described from Argentina, this rust is well known in the southern United States. This appears to be the first report from Brazil.

PUCCINIA KAERNBACHII (P. Henn.) Arth. Bull. Torrey Club **46**: 110. 1919.
On *Andropogon condensatus* H.B.K., Vicosa, June 3, 1933, *567*.
Andropogon semiberbis (Nees.) Kunth., Uberlandia, May 16, 1936, *1071*.
Andropogon sp., Vicosa, Nov. 24, 1929, *30*.
Imperata braziliensis Trin., Vicosa, Mar. 20, 1930, *154*.

PUCCINIA LANTANAE Farl. Proc. Am. Acad. Sci. **18**: 83. 1883.
On *Lantana trifolia* L., Vicosa, Dec. 23, 1933, *666*.

PUCCINIA LATERITIA Berk. & Curt. Jour. Phila. Acad. Sci. **2**: 281. 1853.
On *Borreria latifolia* (Aubl.) Schum., Vicosa, Jan. 7, 1930, *115*.
Diodia prostrata Sw., Uberlandia, May 16, 1936, *1078*.

PUCCINIA LEONOTIDIS (P. Henn.) Arth. Mycologia **7**: 245. 1915.
On *Leonotis nepetaefolia* (L.) R. Br., Vicosa, April 21, 1933, II & III, *480*.

PUCCINIA LEVIS (Sacc. & Bizz.) Magnus, Ber. Deuts. Bot. Ges. **9**: 190. 1891.
On *Brachiaria plantaginea* (Link) Hitch. = *Panicum plantaginea*, Vicosa, Mar. 22, 1933, *417*.
Panicum Millegrana Poir., II & III, Vicosa, Mar. 29, 1933, *429*.
Panicum Sellowii Nees, Vicosa, June 3, 1933, *565*.
Paspalum pilosum Lam., Vicosa, Mar. 22, 1933, *418*; June 4, 1933, *588*; Dec. 23, 1933, *664*.
Paspalum Urvillei Steud., Vicosa, June 3, 1933, *571*.
Tricholaena rosea Nees, Vicosa, Dec. 3, 1929, *40*.

Specimen *565* has uredospores with four equal pores and teliospores slightly smaller than normal. Specimen *571* has spores darker in color than is usual, but agrees well in all other respects.

PUCCINIA LIBERTA Kern, Mycologia **11**: 142. 1919.
On *Eleocharis nodulosa* (Roth) Schultes, Vicosa, April 21, 1936, *1046*.

PUCCINIA MALVACEARUM Bertero; Mont. in C. Gay, Fl. Chile **8**: 43. 1852.
On *Althea rosea* (L.) Cav., Vicosa, Dec. 12, 1933, *649*.
Malva parviflora L., Lacutinga, Nov. 3, 1934, *858*.
?Malva rotundifolia L., Vicosa, Mar. 5, 1932, *307*.
Malva sylvestris L., Vicosa, June 10, 1932, *351*.
Malvastrum coromandelianum (L.) Garcke Sapacahy, Nov. 3, 1934, *857*.

PUCCINIA MEDELLINENSIS Mayor, Mém. Soc. Neuch. Sci. Nat. **5**: 497. 1913.
On *Hyptis muricata* Schott., Vicosa, June 22, 1935, *943*.
Hyptis sp., Vicosa, May 21, 1933, *547*.

These specimens bear only uredinia and are referred here not without some doubt. The spores, however, appear typical, are small and thin-walled.

PUCCINIA OFFUSCATA Arth. Bull. Torrey Club **47**: 469. 1920.
On *Zornia diphylla* (L.) Pers., Vicosa, Mar. 12, 1935, *882*.

PUCCINIA OBLECTANEUS Jackson & Holway, Mycologia **18**: 146. 1926.
On *Rynchospora* aff. *corymbosa* (L.) Britton, Uberaha, May 15, 1936, *1075*.

PUCCINIA OXALIDIS (Lév.) Dietel & Ellis; Dietel, Hedwigia **34**: 291. 1895.
On *Ionoxalis martiana* (Zull.) Small, Vicosa, May 8, 1930, *174*.

PUCCINIA PASPALICOLA (P. Henn.) Arth. Man. Rusts of U. S. & Canada p. 127. 1934.
On *Panicum millegrana* Poir., II, Vicosa, Mar. 11, 1933, *401*.
Paspalum conjugatum Berg., Vicosa, Dec. 12, 1933, *650*.
Paspalum mandiocanum Trin., Vicosa, May 8, 1930, *172*; March 30, 1933, *435*.

Paspalum paniculatum L., Vicosa, Dec. 4, 1929, *70.*
Paspalum plicatum Michx., II, Curvello, Mar. 1, 1935, *1003*, *1004*; Corintho, Mar. 1, 1936, *1005.*
Syntherisma digitata (Sw.), Hitch., II, Vicosa, May 20, 1933, *540.*
Syntherisma sanguinalis (L.) Scop., Uberlandia, May 16, 1936, *1007.*

PUCCINIA PAULENSIS Rangel, Arch. Jard. Bot. Rio-de-Janeiro **2**: 70. 1918.
On *Capsicum frutescens* L., O, I, III, Vicosa, Nov. 16, 1929, *25.*
Capsicum microcarpon DC., I, III, LaVras, July, 1934, *987.*

This is apparently an opsis form, and agrees well with Rangel's description and drawings. We have not had any authentic specimen for comparison.

PUCCINIA POLYGONI-AMPHIBII Pers. Syn. Fung. *227.* 1801.
On *Persicaria setacea* (Baldw.) Small, Vicosa, June 10, 1933, II, *612.*

PUCCINIA POLYPOGONIS Speg. Anal. Mus. Nac. Buenos Aires **19**: 300. 1909.
On *Polypogon elongatus* H.B.K., Cajury, Oct. 12, 1931, *294.*

Was taken at Barbacena Minas Geraes, by Holway no. *1392.*

PUCCINIA POROPHYLLI P. Henn. Hedwigia Beibl. **39**: 153. 1900.
On *Porophyllum ellipticum* DC., Vicosa, Feb. 26, 1930, *198.*

PUCCINIA PITHECOCTENII Paz. Hedwigia **30**: 199. 1891.
On *Pithecoctenium cordifolium* Mart., Vicosa, June 8, 1933, *608.*

PUCCINIA PSIDII Wint. Hedwigia **23**: 171. 1884.
On *Eugenia* sp., Ana Florencia, Nov. 3, 1932, *378*; Vicosa, Mar. 31, 1931, *252.*
Jambos Jambos (L.) Millsp., Ponte Nova, May 3, 1930, *170.*
Marlierea edulis Niedenzu, Vicosa, May 30, 1932, *348.*
Myrcia sp., Vicosa, Oct. 23, 1931, *298.*
Myrciaria cauliflora Berg., Vicosa, Dec. 8, 1929, *74*; Vicosa, Oct. 22, 1936, *1114.*

Myrtaceae sp. indet., Vicosa, Jan. 7, 1930, *116*.
Psidium Guajava L., Sylvestre, Feb. 20, 1932, *303*.
Psidium sp., Araponga, Apr. 30, 1932, *337*.

On *Myrciaria* (Specimen *74*) are abundant telia as well as uredinia. The teliospores are irregularly ellipsoid, 18–20 × 34–50 μ, usually somewhat constricted; wall pale cinnamon-brown, about 1.5 μ thick, not or only slightly thickened above, smooth. *Uredo Rochaei* Putt. is the only rust known to us to have been reported on *Myrciaria*. While no specimen of it has been seen, it seems likely that it will be found to be identical with *P. Psidii*.

PUCCINIA PTEROCAULI P. Henn. Hedwigia **35**: 240. 1896.
On *Pterocaulon alopecuroideum* (Sw.) DC., II, Crasto, April 30, 1933, *518*.
Pterocaulon pycnostachyum (Lam.) DC., II, Vicosa, April 21, 1936, *1048*.

This specimen bears only urediniospores which agree with the brief description Sydow, Monog. Ured. **1**: 138. We have had no authentic specimens for comparison.

PUCCINIA PURPUREA Cooke, Grevillea **5**: 15. 1876.
On *Holcus halepensis* L., Vicosa, Nov. 19, 1930, *217*.
Holcus Sorghum L., Vicosa, Nov. 11, 1929, *59*; Mar. 1, 1934, *745*.
Sorghum arundinaceum (Willd.) Stapf., Pedro Leopoldo, Jan. 27, 1934, *686*.
Sorghum arundinaceum appears to be a new host.

PUCCINIA RHAMNI (Pers.) Wettst. Verh. Zool.-Bot. Ges. Wien **35**: 545. 1886.
On *Avena sativa* L., Vicosa, Feb. 23, 1931, *240*; Nov. 9, 1931, *271*; Lavras, Sept. 1933, *985*.

PUCCINIA ROTUNDATA Dietel, Hedwigia **36**: 32. 1897.
On *Vernonia brasiliana* (L.) Ekm., Corintho, Mar. 2, 1936, *1008*.
Vernonia aff. *crotonoides*, Vicosa, June 8, 1933, *609*.
Vernonia ferruginea Les., Uberlandia, May 17, 1936, *1076*.

PUCCINIA RUDERARIA Jackson & Holway, Mycologia **24**: 153. 1932.

On *Baccharis oxyodonta* DC., Vicosa, Sept. 2, 1934, *835*.

Known only from Brazil.

PUCCINIA RUBIGO-VERA (DC.) Wint. in Rab. Krypt.-Fl. **1**: 217. 1881.

On *Triticum aestivum* L., Bello Horizonte, July 13, 1935, *955*.

PUCCINIA SORGHI Schw. Trans. Am. Phil. Soc. II. **4**: 295. 1832.

On *Zea Mays* L., Vicosa, Oct. 11, 1929, *50*; Feb. 24, 1932, *306*.

PUCCINIA SPILANTHICOLA Mayor, Mém. Soc. Neuch. Sci. Nat. **5**: 531. 1913.

On *Spilanthes acmella* L., Vicosa, May 3, 1934, *783*.

Spilanthes ocymifolia (Lam.) A. H. Moore, Vicosa, Dec. 20, 1933, *660*.

PUCCINIA SUBSTRIATA Ellis & Barth. Erythea **5**: 47. 1897.

On *Chaetochloa geniculata* (Lam.) Millsp. & Chase, II, Vicosa, Jan. 4, 1930, *114*.

Paspalum mandiocanum Trin., Vicosa, Dec. 20, 1933, *661*.

Paspalum paniculatum L., Vicosa, June 6, 1933, *570*.

Paspalum plicatum Michx., Vicosa, Mar. 12, 1932, *313*.

RAVENELIA INDIGOFERAE Tranz. Hedwigia **33**: 369. 1894.

On *Indigofera Anil* L., II & III, Vicosa, May 20, 1934, *788*.

SPHENOSPORA YURIMAGUASENSIS (P. Henn.) Jackson, Mycologia **18**: 153. 1926.

On *Smilax papyracea* Poir., Vicosa, April 29, 1933, *513*.

TRANZSCHELIA PUNCTATA (Pers.) Arth. Résult. Sci. Congr. Bot. Vienne 340. 1906.

On *Amydalus* (nectarine), Vicosa, Feb. 12, 1935, *873*.

Prunus domestica L., Vicosa, Feb. 1, 1930, *117*.

Amydalus Persica L., Vicosa, Oct. 8, 1929, *49*.

UREDO BORRERIAE (P. Henn.) Kern & Whetzel, Mycologia **18**: 42. 1926.
On *Borreria* sp., Vicosa, May 8, 1935, *935*.

Uredo Cassiae-rugosae sp. nov.

Uredosoriis hypophyllis, numerosis, sparsis vel in maculis bruneolis aggregatis, 0.2–0.4 mm. diam. mox nudis pulverulentis obscure cinnamomeo-brunneis; paraphysibus nullis; uredosporis ellipsoideis vel obovoideis, 19–23 × 26–35 μ; tunica aurato-vel pallide cinnamomeo-brunnea, 1–1.5 μ cr. dense echinulata; poris 3–4 equatorialibus.

On *Cassia rugosa* Don., Uberlandia, May 19, 1936, *1083*.

UREDO CUPHEAE P. Henn. Hedwigia **34**: 99. 1895.
On *Cuphea* sp., Uberlandia, May 16, 1936, *1073*.

UREDO ERYTHROXYLONIS Graz. Bull. Soc. Myc. Fr. **7**: 152. 1891.
On *Erythroxylon ovifolium* Peyr., Ouro Preto, May 1, 1933, *522*.
Erythroxylon Pelleterianum St. Hel., Vicosa, June 3, 1933, *569*.

UREDO HYMENAEAE Mayor, Mém. Soc. Neuch. Sci. Nat. **5**: 585. 1913.
On *Pettogyne discolor* Vog., Herval, May 29, 1934, *785*.

This is a new host for Mayor's *Uredo*, also a first report for Brazil.

UREDO MACELLA Jackson and Holway, Mycologia **18**: 150. 1926.
On *Juncas* sp., Vicosa, April 21, 1936, *1047*.

UREDO MELINIDIS Kern, Mycologia **30**: 550. 1938.
On *Melinis minutiflora* Beauv., Vicosa, July 28, 1930, *202*.

Originally described from Venezuela, where three collections have been made. This constitutes the second report of the species.

UREDO PSYCHOTRIICOLA P. Henn. Hedwigia **34**: 321. 1895.
On *Palicourea* sp., Vicosa, May 26, 1934, *808*.

We have had no opportunity to study an authentic specimen of *Uredo psychotriicola*. Consequently this disposition of our speci-

men is not without some doubt. It is certainly not unlike *Puccinia fallaciosa* which is known only from North America. Telia are lacking, however, and the markings on the urediospores are coarser than those of *P. fallaciosa*, and agree well with Henning's description of *U. psychotriicola* which was described from Brazil.

UREDO TERMINALIAE P. Henn. Hedwigia **34**: 321. 1895.
On *Terminalia hylobates* Eichl., May 17, 1936, *1074*.

While we have no authentic specimen for comparison, this collection agrees well with the description (Sydow, Monog. Ured. **4**: 445. 1924). The four pores are often basal, rather than equatorial.

UREDO TRICHILIAE Arth. Mycologia **9**: 90. 1917.
On *Trichilia Weddellii* C.O.C., Vicosa, Mar. 24, 1933, *421*.

UREDO ULEANA Dietel, Hedwigia **36**: 36. 1897.
On *Heteropteris coriaceae* Juss., Lagoa Santa, July 16, 1935, *959*.

Uredo Uleana was described by Dietel from a specimen of E. Ule collected in Minas Geraes and said to be on some undetermined Malpighiaceae. No specimen has been available for comparison but the collection here cited agrees so well with Dietel's description that it is placed here with confidence.

Uredo vicosiana sp. nov.

Uredosoris hypophyllis, sparsis vel paucis in maculis decoloratis dispositis, minutis, 0.2–0.5 mm. diam., pallide flavis, pulverulentis; epidermide rupta visibili; uredosporis late ellipsoideis, 16–19 × 19–25 μ; tunica subhyalina, 1–1.5 μ cr., minute verrucosa; poris obscuris.

On *Cleome spinosa* Jacq., Vicosa, Feb. 4, 1934, *689*.

Other rusts on *Cleome* are *Puccinia Cleomis*, a micro form, and aecia of *Puccinia subnitens*. No previous record of a *Uredo* has been found.

UROMYCES ANGURIAE Jackson & Holway, Mycologia **24**: 101. 1932.
On ? *Gurania* aff. *pycnocephala* Harms., Vicosa, Apr. 1, 1933, *440*.

This species which was described from Brazil on *Anguria Warmingiana* differs from the several others on the family *Cucurbitaceae*

in having verrucose teliospores. It is supposed to be an autocious eu form, but aecia have not been described. This is the second report of the species. While there is some doubt about the host species, the rust agrees well with the type and is placed here without hesitation.

UROMYCES APPENDICULATUS (Pers.) Fries, Summa. Veg. Scand. 514. 1849.
On *Phaseolus vulgaris* L., II, Vicosa, Feb. 7, 1930, *103*.

UROMYCES ASCLEPIADIS (Schw.) Cooke, Grevillea **5**: 152. 1879.
On *Asclepias curassavica* L., II, Vicosa, June 4, 1933, *587*.

UROMYCES BIDENTICOLA (P. Henn.) Arth. Mycologia **9**: 71. 1917.
On *Bidens pilosa* L., II, Vicosa, Jan. 7, 1934, *674*; Feb. 17, 1934, *728*.
Bidens rubifolius H.B.K., II & III, Vicosa, May 2, 1931, *267*.

UROMYCES BLAINVILLAE Berk. Jour. Linn. Soc. **14**: 92. 1873.
On *Blainvillea rhomboidea* Cass., Leopoldina, July 16, 1934, *826*.

UROMYCES BOMAREAE P. Henn. Hedwigia **38**: 67. 1899.
On *Bomarea* sp., II & III, Vicosa, Dec. 3, 1929, *41*.

UROMYCES DOLICHOSPORUS Dietel & Holway; Holway, Bot. Gaz. **31**: 327. 1901.
On *Tournefortia villosa* Salzm., Vicosa, April 8, 1933, *449*.

UROMYCES ERAGROSTIDIS Tracy, Jour. Myc. **7**: 281. 1893.
On *Eragrostis pilosa* (L.) Beauv., II, Vicosa, Feb. 12, 1930, *123*.

UROMYCES FABAE (Pers.) DeBary, Ann. Sci. Nat. IV. **20**: 80. 1863.
On *Vicia Faba* L., Vicosa, Nov. 18, 1929, *26*.

UROMYCES HEDYSARI-PANICULATI (Schw.) Farl.; Ellis, N. Am. Fungi *246*. 1879.
On *Desmodium supinum* (Sw.) P.DC., Vicosa, May 20, 1933, *541*.

This collection bears telia which are not common in other South American collections. They resemble the telia found in North

America, but there may be some doubt as to whether any South American collections are properly referred to this species.

?UROMYCES IMPERFECTUS Arth. Bull. Torrey Club **47**: 472. 1920.
On *Bauhinia Nurandiana* Pittier, Ureraba, May 15, 1936, *1077*. *Bauhinia* sp., II & III, Cajury, Oct. 13, 1931, *296*; Vicosa, Feb. 17, 1934, *741*.

Whether this is the same as *U. superfixus* Vesterg. as suggested in Venezuela list (Monog. Univ. Puerto Rico Ser. B, no. 2: 301. 1934) is still a question. Specimen *296* bears mostly telia, but a few uredospores are present. Specimen *741* bears only the uredo stage. These Uredos agree with Arthur's species and the telia which have only a pale umbo could not be called coronate.

UROMYCES LEPTODERMUS Sydow; Sydow & Butler, Ann. Myc. **4**: 430. 1906.
On *Panicum antidotale* Retz., II & III, Vicosa, May 3, 1934, *784*; II, Vicosa, Jan. 3, 1935, *862*; II, Vicosa, June 22, 1935, *984*.

The best collection of telia seen. This is an Asiatic grass and not a native of Brazil. Since the rust was originally described from East India this may explain the abundant development of telia which have been rarely found on collections from the Western Hemisphere.

UROMYCES MEDICAGINIS Pass. Thüm. Herb. Myc. Oecon. *156*. 1874.
On *Medicago sativa* L., II, Bello Horizonte, Nov. 1, 1929, *185*.

UROMYCES NOVISSIMUS Speg. Anal. Soc. Ci. Argent. **10**: 134. 1880.
On *Cayaponia* aff. *racemosa* (Sw.) Cogn., II & III, Vicosa, Mar. 11, 1933, *402*.

Whether this species is actually distinct from *U. Hellerianus* Arth., as applied to collections from Central America and the West Indies, is doubtful. More ample collections from South America would no doubt clear up this point.

UROMYCES ORBICULARIS Dietel, in Hedwigia **36**: 28. 1897.
On *Meibomia* sp., I & III, Bello Horizonte, Jan. 1, 1934, *687*.

The epiphyllous telia associated with hypophyllous aecia and the absence of uredinia seem to make this species quite distinct.

UROMYCES PROEMINENS (DC.) Pass. Rab. Fungi Eur. *1795*. 1873.
On *Chamaesyce hirta* (L.) Millsp., I, II, III, Vicosa, Mar. 12, 1930, *150*.

UROMYCES RATUS Jackson & Holway, Mycologia **24**: 102. 1932.
On *Cayaponia pentaphylla* Cogn., II, Vicosa, May 25, 1933, *550*.

Agrees well with the type although no teliospores were found.

UROMYCES SCLERIAE P. Henn. Hedwigia Beibl. **38**: 67. 1899.
On *Scleria* sp., II & III, Vicosa, April 22, 1933, *487*.

UROMYCES SPERMACOCES (Schw.) M. A. Curt. Cat. Pl. N. Car. *123*. 1867.
On *Spermacoce tenuior* L., II, Vicosa, April 18, 1933, *472*.

We have no previous record of this rust in South America. Our specimen bears only urediniospores and consequently is placed here with some doubt.

THE PENNSYLVANIA STATE COLLEGE,
STATE COLLEGE, PENNA.

SPECIES OF CORDYCEPS[1]

E. B. MAINS

(WITH 2 FIGURES)

Recently the writer had the privilege of studying specimens of *Cordyceps* in the Farlow Herbarium of Harvard University, the Mycological Herbarium of the New York Botanical Garden, and the Mycological Collections of the United States Bureau of Plant Industry, and he wishes to express his appreciation to D. H. Linder, F. J. Seaver and J. A. Stevenson for the help and facilities afforded. Results of this study are included in the following account. One species, *Cordyceps myrmecophila,* obtained by A. H. Smith during the summer of 1939 is also discussed.

CORDYCEPS UNILATERALIS (Tul.) Sacc.

This is a very interesting species on ants. It is fairly common in the tropics but has been rarely collected in the United States, being reported only from Michigan (as *C. formicivora* Schroet., **17**), Maine (**16**) and North Carolina (**9**). There is also a specimen in the Herbarium of the New York Botanical Garden on the ant, *Camponotus castaneus* var. *americanus* collected by M. E. Smith at A. and M. College, Mississippi, and another in the Mycological Collections of the United States Bureau of Plant Industry, on an ant collected by L. E. Miles at Wiggins, Mississippi.

Cordyceps monticola sp. nov.

Clavis capitatis, 2–2.5 cm. longis, stipitibus subcinereis, 1.5–2 mm. crassis, capitibus subglobosis, brunneo-cinereis, 3 × 3–4 mm.; peritheciis immersis, fusoideo-ovoideis, 600–660 × 200–240 μ; ascis cylindriceis 420–510 × 5–6 μ; ascosporis filiformibus, articulis ascosporarum 6–8 × 1.5 μ (FIG. 1, *A* & *B*).

In *Gryllotalpa hexadactyla,* Vonore, Tennessee, VI. 1935, G. L. Williams.

This specimen has several capitate clavae arising between the head and thorax of the insect and one from between the thorax

[1] Papers from the Department of Botany and the Herbarium of the University of Michigan.

and abdomen. The stipes are light-gray and coalesce for part of their length. Two of the clavae have brownish-gray, globoid heads which are punctate with the dark brown ostioles. The type specimen is in the Mycological Collections of the United States Bureau of Plant Industry.

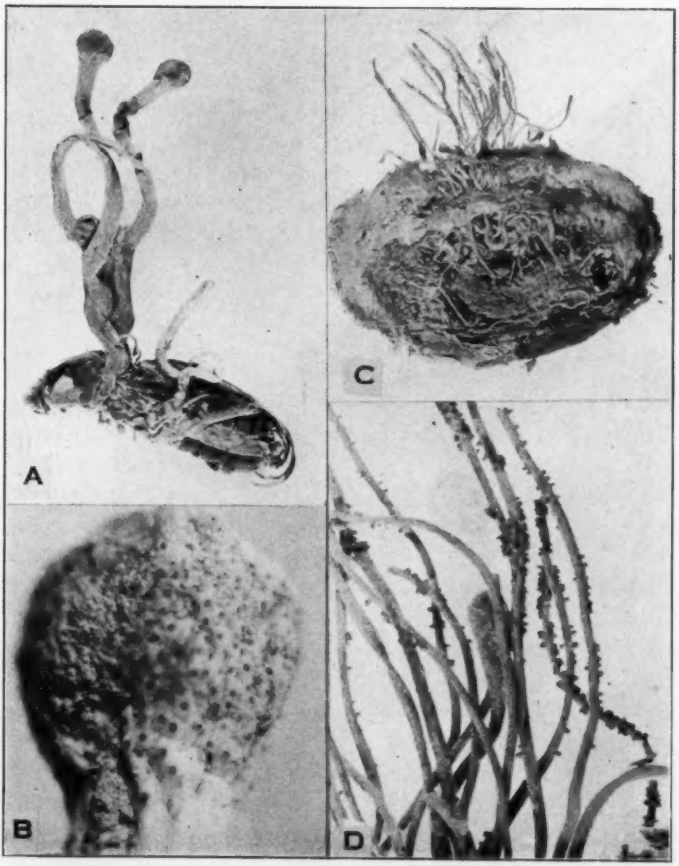

FIG. 1. *A, B. Cordyceps monticola,* type specimen. *A,* clavae arising from *Gryllotalpa hexadactyla,* × 2.4; *B,* head showing ostioles of embedded perithecia, × 12. *C, D. Cordyceps crinalis,* type specimen. *C,* clavae arising from larva in cocoon, × 1; *D,* clavae showing superficial scattered perithecia, × 10.

Under the name *Cordyceps Gryllotalpae*, Lloyd (**8**) has reported a collection in the Herbarium of the New York Botanical Garden. This was apparently named by Curtis but not published. Lloyd gives a photograph but no description other than that the specimens are immature. On account of the lack of description and immature condition it is not possible to determine whether this is the same as the Tennessee collection.

Lloyd also states on very insufficient evidence that *Cordyceps Gryllotalpae* and *C. joaquiens* are the same. The latter was described by Hennings (**5**) and the host doubtfully given as the larva of a beetle. *Cordyceps monticola* differs in a number of important respects.

Petch (**15**) has reported *Cordyceps amazonica* Henn. on mole cricket from Trinidad. This species has much smaller perithecia and asci than *C. monticola*.

CORDYCEPS GRACILIS Mont. & Dur.

Among the specimens of *Cordyceps* in the Curtis Collection of the Farlow Herbarium of Harvard University is a collection with the following data: "*Sphaeria entomorrhiza* Dicks. inter folia ad larvum, Hillsboro, N. C. 1863." There is one capitate clava arising from the head of a caterpillar. The clava is 1.5 cm. long with a stalk 2 mm. thick and a globose, smooth head, 4 mm. in diameter. The caterpillar is surrounded by mycelial strands.

As has been pointed out by Lloyd (**6**) and others, Dickson's name has been generally misapplied to *Cordyceps gracilis*. Petch (**14**) has questioned the occurrence of *C. gracilis* in America and has concluded that the fungus reported as such is *C. Glaziovii* P. Henn., a similar species on beetle larvae in South America. There seems no question but that the Curtis specimen is *C. gracilis*. Both the host and the development which Petch emphasizes are those of *C. gracilis*.

CORDYCEPS CRINALIS Ellis ex Lloyd.

In 1892, Ellis and Everhart (**4**) under the name *C. Sphingum*, published a detailed description and illustration of a *Cordyceps* collected at Newfield, N. J. In 1920, Lloyd (**8**) stated that Ellis

had named the specimen *Cordyceps crinalis* but afterwards had concluded that it was *C. Sphingum*. Lloyd decided that it was not *C. Sphingum* and that Ellis' manuscript name should apply.

The specimen in the Herbarium of the New York Botanical Garden bears the name *Cordyceps crinalis* Ellis & Ev. with a line drawn through the specific name and *C. Sphingum* written underneath. It also bears the following statement, " on larva enclosed in its cocoon attached to a decaying limb lying on the ground in the swamp, Newfield, Aug. 7, '87." The cocoon has been opened exposing the lepidopterous larva within. The clavae are now somewhat broken. They are numerous, brownish-gray, filiform, up to 4.5 cm. long, and 0.2–0.3 mm. thick (FIG. 1, *C* & *D*). The perithecia are chestnut-brown, superficial, free, scattered or crowded on the upper part of the clavae, ovoid with obtuse apices, 310–360 × 180–240 μ. The asci are slightly fusoid, 150–180 × 8–9 μ, narrowing to 3–4 μ above. The ascospores are filiform, somewhat overlapping in the ascus, 1.5 μ thick, obscurely multiseptate. Ellis and Everhart state that there were approximately 30 clavae which were about 5 cm. long and that a few were sparingly branched above.

This as Lloyd has indicated is a valid species. It is closely related to *Cordyceps acicularis* from which it differs in having smaller perithecia and asci and more numerous caespitose clavae. *Cordyceps acicularis* has been reported only on larvae of beetles.

CORDYCEPS RICKII Lloyd.

Cordyceps Rickii was published by Lloyd (**8**) in 1920 with a brief description and several figures. Lloyd compared it with *C. submilitaris* from which he concluded it was distinct. Petch (**14**) in 1933 decided that it was synonymous with *C. martialis* in which species he also placed *C. submilitaris*. Later Petch (**16**) has suggested that *C. Rickii* might be *C. Melolanthae*.

The collections of this species (*37238* type, *41268* and *41275*) in the Lloyd Herbarium, now in the Mycological Collection of the United States Bureau of Plant Industry have been examined. Usually several clavae arise from a large white larva of a beetle. The clavae are club-shaped or irregularly furcate, 3.5–6 cm. long (FIG. 2, *A*). The stipes are brown, 3–5 mm. thick and often co-

alesce. The fertile portion is light brown to brownish-yellow, and is up to 2 cm. long and 5–10 mm. thick. The perithecia are entirely embedded and are ovoid, 540–600 × 200–240 μ.

Cordyceps Rickii is very distinct from both *C. submilitaris* and *C. martialis,* both of which have orange to red clavae. It does not differ greatly from *C. Melolanthae.* The latter tends to have somewhat thicker clavae with the fertile stroma irregularly distributed more or less in patches on the upper part of the clavae. The differences, however, are not sufficient to separate them as species and *C. Rickii* should be considered a synonym of *C. Melolanthae.*

CORDYCEPS (TORRUBIELLA) ARACHNOPHILA Thaxter.

This name was published by Thaxter (**20**) in 1914 in an article concerning the genus *Aschersonia.* No description is given, only the statement that in some cases the perithecial stages of *Aschersonia* " might at first be mistaken for a common *Cordyceps* (*Torrubiella*) *arachnophila* which is often found on leaves with or without its imperfect or *Isaria* (*Gibellula*) condition." No description of this species has been located.

In the Farlow Herbarium, however, there is a collection (Farlow Herb. no. *6169*) on a spider made by R. Thaxter, Aug. 2, 1896, at Cranberry, N. C., which is labeled *Cordyceps arachnophila.* This has a few perithecia associated with a *Gibellula* stage. There is also another collection of this species (Farlow Herb. no. *4122*) under an unpublished name. This contains a number of small spiders bearing perithecia and the *Gibellula* stage. The spiders are covered with a white or yellowish cottony mass of mycelium, only the legs sometimes showing. The perithecia are brown and develop directly from the mycelial covering (FIG. 2, *B*). They are conical ovoid, 840–1200 × 300–360 μ. The asci are narrowly cylindric, 600–660 × 5–7 μ and the ascospores filiform, nearly as long as the asci and are 1.5 μ wide and multiseptate, the septa 6–10 μ apart. The conidial stage develops on clavae which are up to 7 mm. long, 0.1–0.2 mm. thick and which enlarge at the apices up to 0.2–0.4 mm. The clavae are covered with a network of brownish, septate hyphae from which the conidiophores arise. The hyphae and conidiophores have rough walls. The conidiophores are up to 180 μ long and 8 μ wide. The terminal cell is

smooth, hyaline, and slender and supports a spherical head which is 36–42 μ in diameter and consists of brownish, clavate, radiating cells from which hyaline cylindric conidia are produced. The conidia are 4–6 $\times$ 1–1.5 μ. The conidial stage is apparently *Gibellula aranearum*.

The lack of perithecial clavae and the development of perithecia on the mycelial covering would place this species in the genus

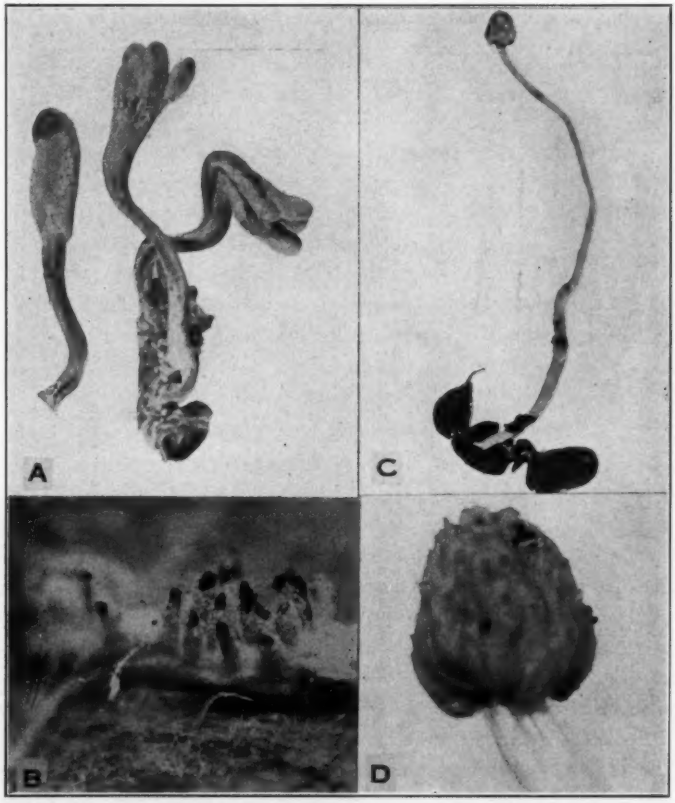

FIG. 2. *A, Cordyceps Rickii,* type specimen, $\times$ 1; *B, Torrubiella Gibellulae* showing perithecia, $\times$ 10; *C, D, Cordyceps myrmecophila: C,* clava arising from an ant, $\times$ 2.4; *D,* head showing obliquely embedded perithecia, $\times$ 12.

Torrubiella. In 1932, Petch (**13**) announced the discovery of perithecia associated with *Gibellula aranearum* in collections from Ceylon and Trinidad to which he gave the name *Torrubiella Gibellulae.* His description of the species differs from the above in having smaller perithecia and asci. However a study of collections of *Torrubiella Gibellulae* in the Farlow Herbarium determined by Petch indicates that the species ranges in size up to the measurements given above. Since Thaxter's name was published without a description it must therefore be listed as a nomen nudum under *Torrubiella Gibellulae* Petch.

CORDYCEPS CUSU Pat.

In 1895 Patouillard (**12**) gave the name *C. Cusu* to a specimen from San Jorge, Ecuador. The host is given as the larva of a beetle and it is stated that all the clavae were sterile. The specimen in the Patouillard collection in the Farlow Herbarium of Harvard University was examined. It apparently is a sterile plant of *Cordyceps Rickii* and the name therefore should be placed in the synonymy of *Cordyceps Melolanthae.*

CORDYCEPS COCKERELLII Ellis.

Ellis (**3**) described a species as *Ophionectria Cockerellii* from specimens received from T. D. A. Cockerell and a short time later (**2**) changed the name to *Cordyceps Cockerellii.* Cockerell (**2**) stated that the hosts were the moths, *Philampelus vitis* and *Coccytius antoeus.* These specimens are in the Herbarium of the New York Botanical Garden. One specimen is covered with a meager yellowish mycelium from which a few sterile protuberances arise. The perithecia are scattered in small groups on the mycelial covering of the moth. They are superficial, free, reddish brown, ovoid, 600–900 × 300–400 μ. The asci are cylindric, 200–230 × 5 μ and the ascospores are filiform, nearly as long as the asci. The other specimen consists of a few short clavae bearing immature superficial perithecia.

As Lloyd (**7**) has pointed out *C. Cockerellii* is *C. Sphingum,* a very variable species in which sometimes clavae are not produced and the perithecia develop on the mycelial covering of the host.

CORDYCEPS ACICULARIS Rav. ex Berk.

This species was published by Berkeley (**1**) in 1857 and was based on a collection made by Ravenel in South Carolina. The host is given as a caterpillar. Ravenel issued the species under the name *C. carolinensis* in his Fungi Caroliniani Exsiccati IV—*29*. Specimens of this number have been examined from the collections of the Farlow Herbarium, the New York Botanical Garden, the Academy of Natural Science of Philadelphia and the Mycological Collections of the United States Bureau of Plant Industry. The hosts of all of these are larvae of a beetle of the type commonly known as wire worms. Petch (**14**) also reports that the specimens in the herberia of Kew and the British Museum including the specimen cited by Berkeley (Rav. *1276*) are on the larvae of a beetle. The species apparently has been reported only for South Carolina and Pennsylvania (**11**). Specimens examined from several herbaria add collections from Connnecticut, New Hampshire and Ontario.

The following description is taken from these collections: Clavae ochraceous to grayish-brown, slender, 2–10 cm. long, 0.3–1.0 mm. thick, the apices acuminate and sterile; perithecia superficial, free, scattered or irregularly crowded on the upper portion of the clavae, ovoid, 360–400 × 270–300 μ; asci somewhat clavate, 190–240 × 7–10 μ; ascospores narrowly fusoid, 100–220 × 2.5–3.5 μ, overlapping in the ascus, septa obscure, apparently not breaking into segments.

Specimens examined: South Carolina, Rav. Fungi Car. IV, *29*; Lower Bartlett, N. H., Sept. 3, 1901, R. Thaxter (Farl. Herb. *4030*); West Haven, Conn., 1888–1889, R. Thaxter (Farl. Herb. *6131*); West Haven, Conn., Oct. 1888, R. Thaxter (Farl. Herb. *6136*); Toronto, Canada, June 10, 1899, J. Fletcher (Farl. Herb.); Toronto, Canada, Oct. 1898, C. W. Nash (Myc. Coll. B. P. I.); Laurel Run, Hunt Co., Penn., Aug. 13, 1937, B. B. and L. O. Overholts (*20215*).

Only two of these collections (Farl. Herb. *4030* and Overholts *20215*) bear perithecia. Petch (**14**) has also noted that many of the collections of this species are sterile. He places the species in *Ophiocordyceps*.

CORDYCEPS RAVENELII Berk. & Curt.

Berkeley (**1**) published *C. Ravenelii* in 1857 in the same article with *C. acicularis* but on the following page. Petch (**14**) considers this species the same as the latter and therefore places the name in synonymy with *C. acicularis*. However according to Berkeley's description and illustration, and the specimen in Ravenel's Fungi Caroliniani, *C. Ravenelii* has club-shaped clavae with obtuse or at the most acute apices which are often sterile and tends to be much darker in color, frequently chocolate-brown. Berkeley gives the hosts as larvae of *Ancylonycha* or *Rhizotrogus* beetles of the Scarabiidae. These larvae are grubs of the June beetle type. Other collections from the United States also have this type of larvae. This is apparently a valid species.

The following description is taken from the specimens listed below: Clavae chocolate-brown, club-shaped, 3–10.5 cm. long, 1.5–2.5 mm. thick below, swelling above to 2–4 mm., the apices obtuse or acute, usually covered with perithecia, sometimes sterile; perithecia superficial, free scattered or crowded on the upper portion of the clavae, dark brown, ovoid, 300–480 × 240–300 μ; asci narrowly clavate, 180–240 × 6–10 μ; ascospores cylindric, 160–190 × 2 μ, somewhat overlapping in the asci, multiseptate, the cells 22–30 μ long, tardily breaking into segments.

Specimens examined; South Carolina, Ravenel Fungi Car. IV, *28*; Cranberry, N. C., Aug. 1887, R. Thaxter (Farl. Herb. *4050*); West Chester, Penn. (N. Y. Bot. Gar.); Ross Run, Hunt Co., Penn., May 16, 1937, L. O. Overholts (*20050*); Intervale, N. H., July 1, 1901, R. Thaxter (Rel. Farl. *613*); South Portsmouth, Ky., John Butler (Lloyd Coll. *41279*); Great Smoky Mts. Nat. Park, Aug. 18, 1938, A. H. Smith (*10327*).

CORDYCEPS MYRMECOPHILA Ces.

Cordyceps myrmecophila was distributed by Rabenhorst in Koltzschii Herb. Myc. *1033* and a description published in Bot. Zeit. **4**: 877. 1846. The species is described as having capitate clavae with slender stipes and ovoid heads which are sterile at the base and ridged above with the perithecia embedded, except for their apices. The color is given as ochroleuca and the host

an ant. Nylander (**10**) has reported the species on the ant, *Formica rufa,* from Finland. He describes the asci as approximately 300 × 6–7 μ.

The species apparently has been rarely collected and information concerning it is scanty. Saccardo (**18**) has reported it from Italy, Finland, Britain, North America, Ceylon and Borneo. Since ichneumon flies and beetles as well as ants are listed as hosts probably other species of *Cordyceps* are included. Seaver (**19**) has questioned the report of the species for North America.

During the summer of 1939, A. H. Smith collected a number of specimens of a *Cordyceps* on ants in the state of Washington. From these the following description has been derived.

Clavae capitate, arising from the thorax of the hosts, slender, 1–4 cm. long, the stipes 1 mm. thick, light yellow, the heads ovoid, 2–2.5 × 1.8–2 mm., ochraceous, acute, longitudinally ridged; perithecia narrowly obovoid, 660–890 × 240–275 μ, embedded obliquely with the ostioles slightly projecting upward; asci cylindric, 500–630 × 4–6 μ; ascospores filiform, nearly as long as the asci, multiseptate, soon breaking into one-celled fragments, 8–10 × 1.5 μ (FIG. 2, *C* & *D*).

On ants, Port Ludlow, May 30 (*13865*); Lake Crescent, June 2 (*13955*), June 3 (*14006*), June 7 (*14157*); Joyce, June 9 (*14206*); Storm King, Olympic Mts., June 12 (*14276*); Elwha River, June 23 (*14575*); Mt. Angeles, June 28 (*14652*).

Apparently these collections are *C. myrmecophila.* Previous descriptions do not mention the oblique perithecia but statements concerning the sterile base and ridged condition of the head indicate that the original specimens probably have oblique perithecia. The asci of the Washington collections are much longer than the measurement given by Nylander. However it is often difficult to obtain entire asci.

The species is closely related to *Cordyceps sphecocephala* which develops on wasps and bees. As the Tulasnes (**21**) have pointed out, it is a smaller species.

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CULTURAL HISTORIES OF MELANCONIS AND PSEUDOVALSA. IV[1]

LEWIS E. WEHMEYER

(WITH 22 FIGURES)

The species of *Melanconis* here considered present further variations from what might be considered as our conception of a "typical" species. *M. nigrospora* represents another case in which reproduction is accomplished exclusively by ascospores, for although perithecia are formed abundantly in nature and all cultures, a conidial stage seems to be entirely lacking.

Melanconis Juglandis var. **Caryae** var. nov.[2]

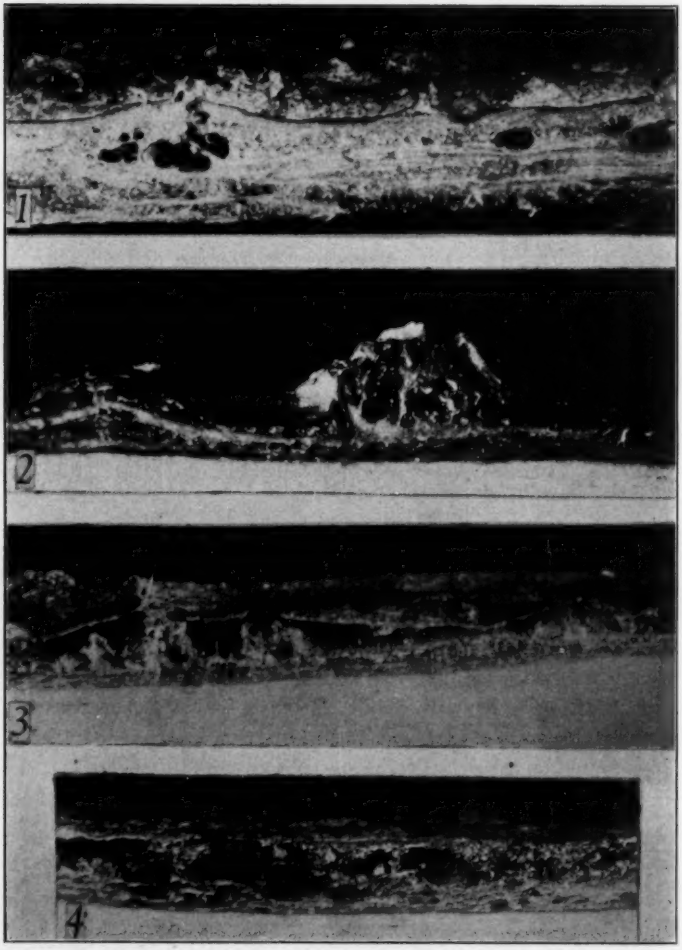
Conidia dimorpha: α formae ellipsoidea vel inaequilateralia vel breviter lunata, 1-cellula, hyalina, 10.5–14 μ longa, 5–7 μ lata, in stromatibus eis Melanconii conformantia. Conidia β formae bacilliformis, 1-cellula, hyalina, 2–2.5 μ longa, 0.8–1.0 μ lata.

In June of 1938, a collection of a *Melanconis* on *Carya alba* was sent to the writer by J. H. Miller, from Tallahassee Shoals, Georgia. This material was at first considered a new species and perhaps should be placed as such. It shows a close relationship to *M. Juglandis* (Ellis & Ev.) Graves, however, differing chiefly in its conidial stage, a situation used for the separations of varietal rank in several other species. The perithecial stromata (FIG. 1) differ from those of *M. Juglandis* on *Juglans* chiefly in the somewhat smaller size and lighter color and their arrangement in rather definite longitudinal series. The ascospores from *Carya* (FIG. 7) measure 17.5–23 × 6–7 (8.5) μ, which places them in the narrower portion of the range of those on *Juglans* (17–23 × 6–9.5 μ), but as only one collection is known, certainly not of specific value.

[1] Papers from the Department of Botany of the University of Michigan, No. 710.

[2] *Melanconis Juglandis* var. *Caryae* var. nov. Ut in forma typica sed stromatibus minoribus, circularibus, pallidis, leniter erumpentibus, confertioribus, plerumque in seriebus linearibus longitudinaliter dispersis.

Sprays of ascospores from this material were made onto nutrient agar on August 23, 1939. After forty-eight hours, the spores were found germinating by from one to three germ tubes, 3.5–4.5 μ in diameter (FIG. 8), from either the ends or the sides of the spores.



FIGS. 1–4, radial sections of perithecial stromata of: 1, *Melanconis Juglandis* (Ellis & Ev.) Graves var. *Caryae*; 2, *Melanconis nigrospora* (Peck); 3, *Melanconis Everhartii* Ellis; 4, *Melanconis Corni*.

Single germinating ascospores transferred to oatmeal agar, grew very slowly causing a reddish brown discoloration of the agar surface and a slight superficial growth of grayish mycelium. Fruiting stromata are scarce or absent on agar cultures.

On November 2, inoculations were made onto autoclaved twigs of *Carya* sp. Growth on these twigs was slow, and after three weeks in the moist culture tubes only a superficial white cottony mycelium, about the point of inoculation, was apparent. By December 29, a number of small spherical stromata, with a white cottony surface, had appeared. Watery droplets and later yellowish to tan colored spore masses were exuded from these stromata. These first stromata were largely superficial, but others, formed later on drier portions of the twigs, were erumpent merely as grayish discs.

The ectostromata (FIG. 5) originated on the bark surface as flattened conic areas of light colored prosenchyma. The central portions of these areas grew upwards rapidly as cylindric to conic plugs which turned a gray or yellowish-brown and ruptured the overlying periderm. The conidial hymenia were initiated over the surface of shallow open cavities on the flanks or marginal flattened areas of the ectostroma, beneath the periderm. The conidia (FIG. 9) arose as apical outgrowths of simple hyaline conidiophores measuring 17–25 $\times$ 1.5–2 μ. At maturity, these conidia were one-celled, hyaline, ellipsoid to inaequilateral or stout lunate, guttulate and 10.5–14 $\times$ 5–7 μ. Conidia produced on agar were similar but more irregular in shape. On drier portions of the twigs, a few slender spore horns of a lighter yellow were seen and examined and found to contain a second type of conidium which was one-celled, hyaline, rod-shaped, and 2–2.5 $\times$ 0.8–1.0 μ. These were sporadic in occurrence and not definitely seen attached to conidiophores, but probably represent a beta type of conidium for this species.

This occurrence of hyaline conidia in a variety of *Melanconis Juglandis,* which itself has brown conidia, corresponds to a similar situation in the variety *marginalis* of *Melanconis Alni* and the var. *carpinigera* of *M. chrysostroma.* All three of these species have hyaline ascospores, suggesting that they represent a primitive group within the genus.

Melanconis Corni sp. nov.[3]

Conidia cylindrica paulum angustata vel ad mediam versus angustiora, 4-cellula, granularia, hyalina, demum 4-guttulata, 17.5–30 μ longa, 7–8 μ lata, in loculis stromatis subcompacti parvis sphaericis vel ovoideis in conidiophoris brevibus simplicibus prolata.

Scarcely visible on the surface or visible as minute pustules of papillate erumpent ostioles, 0.1–0.2 mm. in diameter, or as circular perforations, 0.2–0.3 mm. in diameter. Perithecia 400–500 μ in diameter, in small loose groups in the unaltered bark cortex; walls thick, parenchymatic. Practically no ectostroma visible. Ostioles convergent and often erumpent as a minute disc. Asci long cylindric, with a refractive ring in the apex, 150–160 × 8–9 μ. Paraphyses numerous, broad, band-like, guttulate. Spores overlapping uniseriate, fusoid-ellipsoid, two-celled, brown, constricted at the septum, biguttulate, 16–25 × 7–8.5 μ.

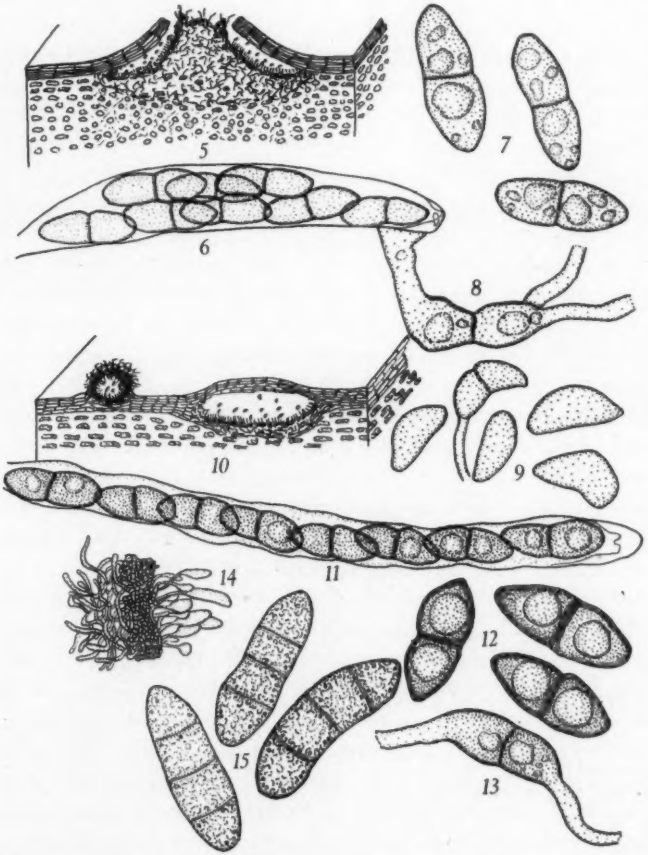
Conidia cylindric, slightly tapered or narrower in the middle, four-celled, granular, hyaline, finally 4-guttulate, 17.5–30 × 7–8 μ, borne on short simple conidiophores in small spheric to ovoid locules within a loosely compacted stroma. Type specimen on *Cornus florida,* coll. J. H. Miller, Campus, Athens, Ga., February 20, 1939. In author's Herb.

Material of this species (FIG. 4) was sent to the writer by J. H. Miller. It was first considered to be related to *Massariovalsa* on account of the slight development of the ectostroma. The ascospores (FIG. 12) are smaller than those of *Massariovalsa sudans* (Berk. & Curt.) Sacc., however, and they are uniseriate (FIG. 11) and lack the gelatinous envelope characteristic of *Massariovalsa.* The conidial stage obtained in culture also indicates that its relationships must be sought elsewhere among the species of *Melanconis.*

Ascospores of this species germinated (FIG. 13) on nutrient agar

[3] *Melanconis Corni* sp. nov. Vix superficialiter visibilis vel minute pustuliformis (pustulis 0.1–0.2 mm. diam. ex ostiolis papillatis erumpentibus constantibus) vel perforationes 0.2–0.3 mm. diam. circulares faciens. Perithecia 400–500 μ diam. laxe gregatim in cortice normali disposita; membranis crassis parenchymatosis. Ectostroma fere nullum. Ostiola convergentia saepe minute disciformia erumpentia. Asci longe cylindrici, apice annulo refringenti praediti, 150–160 μ longi, 8–9 μ crassi. Paraphyses numerosi late liguliformes guttulati. Spori imbricati uniseriati, fusiformes vel ellipsoidales, 2-celluli, brunnei, ad septum constricti, biguttulati, 16–25 μ longi, 7–8.5 μ crassi.

within twenty-four hours by means of germ tubes, 3–3.5 μ in diameter, put out usually first from one and then from the other end, of the spore. On nutrient agar, a black growth is formed within the medium and a slight grayish mycelium appears upon the sur-



FIGS. 5–9. *Melanconis Juglandis* (Ellis & Ev.) Graves var. *Caryae*. 5, radial section of conidial ectostroma; 6, ascus; 7, ascospores; 8, germinating ascospore; 9, conidia as produced in cultures. FIGS. 10–15. *Melanconis Corni*. 10, radial sections of superficial and intraperidermal conidial locules; 11, ascus; 12, ascospores; 13, germinating ascospore; 14, section of wall and hymenium of conidial locule; 15, conidia as formed in cultures.

face. Small grayish, hemispheric stromata soon appeared on the surface along the line of contact between the single spore colonies isolated. These stromata consisted of a loosely compacted weft of brownish hyphae, 3–3.5 μ in diameter, arising from a looser growth of upright hyphae within the agar. The hyphae were more compacted in the upper portion of the stroma, from which area a loose weft of hyaline hyphae arose. Conidia were formed at first throughout this hyaline weft. More rapid spore formation soon gave rise to a more or less open pocket filled with conidia. These conidia (FIG. 15) were cylindric oblong, tapered toward the point of attachment, or often slightly narrower in the middle, hyaline and granular at first, soon becoming four-guttulate and showing three faint septa. They measured 17.5–26 $\times$ 6–8 μ.

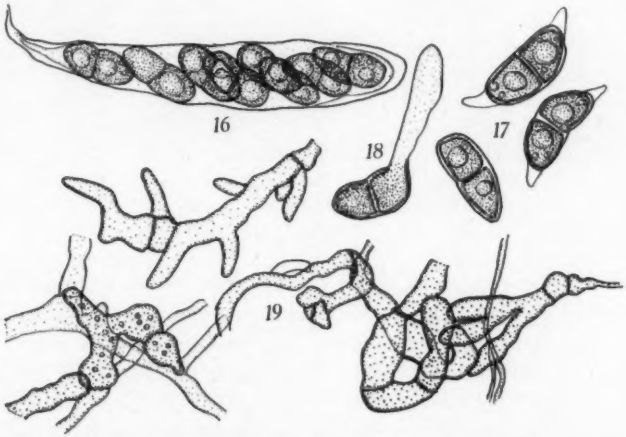
On August 8, 1939, autoclaved twigs of *Cornus florida* were inoculated from single spore cultures. Within three weeks, numerous, minute, superficial, gray, floccose stromata appeared upon these twigs, and eventually exuded yellowish masses or tendrils of conidia. These stromata (FIG. 10) on twigs arose as loosely compacted masses of hyphae, much as described for those on agar. They were formed upon the surface, within the periderm, or rarely just beneath this tissue. Conidial formation within these stromata resulted in a spheric or ovoid locule (FIG. 10) surrounded by a wall-like area of densely compacted hyphae (FIG. 14). Where exposed on the surface, these stromata were covered by a loose floccose tomentum. The conidia on twigs were four-celled, granular, hyaline, 23–30 $\times$ 7–8 μ and very similar to those formed on agar.

This conidial stage is a type heretofore unknown in the genus *Melanconis*. *M. thelebola* has four-celled brown conidia, formed in locules, but the ascospores of that species are hyaline and appendaged and a well developed ectostroma is formed. The affinities of *M. Corni* seem to be with the Pseudoprosthecium group, such as *Pseudovalsa Ulmi* or *P. Berkeleyi*, both of which have a very slightly developed ectostroma and four-celled conidia, hyaline in the former and brown in the latter species. The difficul y in considering *M. Corni* as a two-celled progenitor of the Pseudoprosthecium group lies in the uniseriate and unappendaged condition of the ascospores which are appendaged and biseriate in Pseudoprosthecium. *M. Corni* must remain as another isolated ex-

ample of the variation of the conidial stage within the two-celled *Melanconis* group.

Melanconis nigrospora (Peck) comb. nov.

This is an aberrant species of *Melanconis*. It was described as *Diatrype nigrospora* by Peck in 1880 (Rep. N. Y. State Mus. **33**: 33), as *Melanconis Meschuttii* by Ellis in 1883 (Bull. Torrey Club **10**: 117) and was placed in *Valsaria* as *V. nigrospora* by Berlese & Vogliano (Sacc. Syll. Fung., Add. 129), in 1886. The perithecia (FIG. 2) are formed in a richly developed entostroma which is usually outlined by a definite and complete, blackened, marginal zone. In this respect it resembles the genus *Valsaria*, but it differs in the broad, band-like, evanescent paraphyses and the short, hyaline, triangular appendages on the ascospores (FIG. 17). A co-



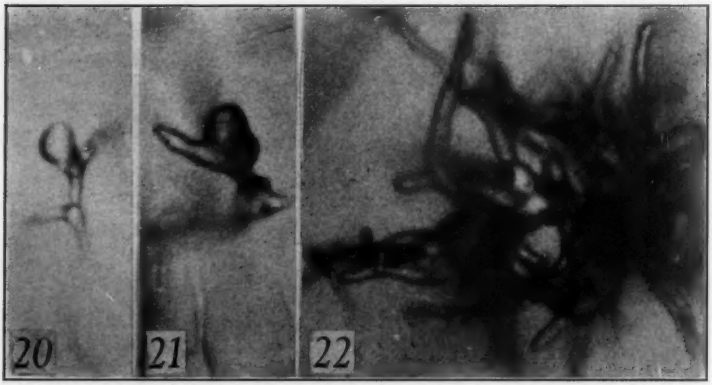
FIGS. 16–19. *Melanconis nigrospora* (Peck). 16, ascus; 17, ascospores; 18, germinating ascospore; 19, various hyphal proliferations representing early stages in the formation of perithecial primordia.

nidial connection would be most desirable here, to aid in determining its relationships, but so far none has been obtained.

Isolations of single ascospores were made from twigs of *Betula alba* collected in Colchester Co., Nova Scotia, in 1935, and from twigs of *Betula sp.* collected near Howell, Michigan, in 1938. The

ascospores germinated (FIG. 18) within twenty-four hours, in both cases, by pushing out a single, short, somewhat clavate germ tube, 3–3.5 μ in diameter.

Growth on agar was slow, forming a powdery white surface growth at first, which later turned brown-black on the agar surface and eventually produced scattered, superficial, confluent, grayish stromata, 1–2 mm. in diameter, which contained numerous peri-



FIGS. 20, 21, earliest stages in the formation of perithecial primordia; 22, later stage of perithecial primordium, showing proliferation to form hyphal knot.

thecial primordia, most of which remained sterile, although they were often seen with a few mature ascospores. On sterilized twigs of *Betula alba*, similar stromata were formed but in greater abundance. No conidial stage was seen in the hundreds of stromata which have been sectioned.

The origin of the perithecium can be followed in the granular marginal growth on nutrient agar but due to the fact that the majority of the perithecia fail to develop normally but form sterile, parenchymatic sclerotic bodies, instead, the details of perithecial development were not followed.

Contrary to our ideas of the origin of the sphaeriaceous perithecium as a definite structure, usually forming a coiled or "Woronin" hypha, these perithecia develop as a vegetative stromatic knot of hyphae. At the point of origin of a perithecium, several

cells of a hypha (FIGS. 20, 21) become irregularly enlarged and put out short stubby branches. This swelling and branching of the hyphae (FIG. 19) continues to form an intertwined knot which soon becomes a spherical mass of tissue (FIG. 22). These primordia arise in large numbers in more or less localized areas. The intermediate hyphae, between the primordia, also enlarge, become darkened in color and form a common stroma in which the perithecia are imbedded. As the perithecium develops, there appears a central "core" tissue of smaller dark staining, concentrically arranged, hyaline hyphae which are surrounded by several layers of dark brown parenchymatous wall tissue. In normal development, this central core gives rise to the ascogenous system within the wall, but under the conditions of agar cultures, most of the perithecial "cores" soon lose their active growth and become transformed into a large-celled pseudoparenchyma similar to that of the wall tissue.

Our knowledge of perithecial origin and development is limited to a comparatively few cases in isolated groups and the prevalent ideas of development often referred to as sphaeriaceous, pseudosphaeriaceous, and dothideaceous will undoubtedly need much revision, and many intermediate series will emerge as our information increases. This species is merely one example of a type which has been generally accepted as sphaeriaceous, from its mature structure, but which shows a type of perithecial origin of a more pseudosphaeriaceous type.

MELANCONIS EVERHARTII Ellis.

This species (FIG. 3) has been isolated from five different collections on twigs of *Acer*. Two of these isolations were lost on account of the slow growth of the germinating ascospores and contaminations on the plates. Three were grown in agar cultures and two isolations were transferred to autoclaved twigs of *Acer Saccharum*. In no case were any indications of conidia or conidial stromata seen.

The ascospores germinate within twenty-four to forty-eight hours, by one, or occasionally two, germ tubes, 5–7 μ in diameter. On oatmeal agar a superficial, white to gray, cobwebby mycelial growth is formed and the surface layers of the agar are blackened.

Scattered, pulvinate, grayish stromata are occasionally formed on agar, but all such stromata examined have been sterile.

On twigs of *Acer*, small erumpent, grayish, ectostromatic discs, 0.5 mm. in diameter are formed. Sections of these show that a small ectostroma, composed of hyaline to brown, rather large-celled parenchyma is formed on the bark surface beneath the periderm. In the base of these stromata, or in a swollen entostromatic area beneath them, perithecial initials, composed of coiled spherical knots of hyphae, are usually found but no conidial stage has ever been seen.

It is unfortunate that no conidial stage could be obtained for this species. Its light-colored ectostromata and large, hyaline, appendaged ascospores suggest that this species may be related to *Melanconis thelebola*, which has four-celled, brown conidia. On the other hand, it might be related to such species, with appendaged ascospores, as *M. Alni*, which have a *Melanconium* imperfect stage. Without any conidial stage, the position of *M. Everhartii* must remain in doubt.

SUMMARY

A new variety of *Melanconis Juglandis* (Ellis & Ev.) Graves, on *Carya*, was found to produce hyaline conidia in *Melanconium*-like pustules.

A new species, *Melanconis Corni*, described from *Cornus florida*, produced four-celled hyaline conidia in locules within a loosely compacted stroma.

Melanconia nigrospora (Peck) and *M. Everhartii* Ellis failed to produce any conidial stage. *M. nigrospora* produced perithecia freely in culture. These perithecia arose from swollen, branching hyphae in a manner not usually associated with the Sphaeriales.

A LEAFSPOT FUNGUS ON NYSSA

FREDERICK A. WOLF

During August and September the two species of tupelo, *Nyssa sylvatica* Marsh and *N. biflora* Walt., occurring within the Duke Forest, may be found to be severely affected with a leafspot disease. The pathogen associated with this disease is one of the pycnidial Fungi Imperfecti known as *Phyllosticta Nyssae* Cooke. Studies of its morphology, however, have shown that *P. Nyssae* is not a pycnidial (conidial) stage but a spermogonial (spermatial) stage. Studies of its developmental cycle, furthermore, have shown that this spermogonial stage is genetically connected with a perithecial (ascigerous) stage that grows on decaying leaves and reaches maturity during spring of the following year. The present report, therefore, embodies the results of these studies and contributes to a better understanding of the structure and identity of this pathogen on tupelo.

APPEARANCE OF TUPELO LEAFSPOT AND ITS DISTRIBUTION

The incidence of this disease does not appear to be correlated with age of the trees although the foliage of small trees is commonly most severely involved. The reason for this appears to be related to the proximity of the leaves of small trees to inoculum contained in decaying leaves on the ground. The presence of scattered, irregular, purplish blotches upon the upper leaf surface constitutes the first evidence of infection. No discoloration of the lower leaf surface is apparent at this time. As the disease progresses the blotches enlarge and may become irregular areas one to three centimeters across. It is not unusual for the entire upper leaf surface to become involved. Meanwhile the lower surface of the lesions becomes dark-brown, and is thickly beset with punctiform dark, fungous structures. As these structures rupture the leaf surface it becomes somewhat cinereous. In case the lesions remain discrete, the intervening leaf areas acquire the purplish

scarlet coloration, characteristic of tupelo leaves in autumn. Premature defoliation follows. After the leaves have fallen the diseased portions become purplish-black above and dark-brown below, and the fungous structures continue to develop and to increase in number to the extent that they may rather uniformly and densely occupy the entire lower leaf surface.

Examination of exsiccati[1] in the Farlow Herbarium, the herbarium of the New York Botanical Garden, and the herbarium of the Division of Mycology and Disease Survey of the U. S. Department of Agriculture show that this fungus has been collected in Alabama, Florida, Georgia, South Carolina, North Carolina, Virginia, West Virginia, and Maryland. Apparently it is confined to the Southeastern United States and is not coextensive in range with that of the several species of *Nyssa*.

IDENTITY OF THE PATHOGEN

Microscopic examination of the minute fungous structures protruding from the lower surface of the lesions shows them to be globular, to occur singly, and to be of two kinds. One kind may be identified as the fructifications of *Phyllosticta Nyssae* (2). In fact, the pathogen under consideration herein has been compared with the type of *P. Nyssae*, no. *798*, collected at Darien, Georgia, by H. W. Ravenel and has been found to be specifically identical with the type. The so-called pycnidia, however, prove to be spermogonia. The interior of mature spermogonia becomes filled with rod-shaped spermatia 3.0–3.5 × 1.0–1.5 μ. The spermatia are embedded in a gelatinous matrix that exudes in droplets or films when moisture conditions are favorable.

The other kind of fungous structures are the perithecial primordia. They are largely constituted of deeply-staining fungous parenchyma. Within each primordium there is a segmented carpogone whose trichogynal portion extends to the exterior.

Both the spermogonia and the primordia of perithecia can be

[1] The writer examined the collections in the herbarium of the New York Botanical Garden. These examinations were facilitated by the courtesies of Dr. F. J. Seaver. Reports on collections in the Farlow Herbarium and in the U. S. Department of Agriculture were made by Dr. D. H. Linder and Dr. W. W. Diehl, respectively. The writer is obligated to each of these mycologists and herewith extends his thanks to them.

found throughout August, September, and well into October. Toward the end of this period the spermogonia are exhausted, and little except the membranaceous spermogonial wall remains, whereas the perithecial initials appear as stromata. By late March or early April of the following spring these stromata will have become transformed into mature perithecia 60–85 μ in diameter. They are globular except for the possession of a short ostiolar papilla that projects slightly above the leaf surface. The perithecial wall is membranaceous, being constituted of thick-walled brown cells. The asci adhere in a fascicle, a characteristic that may best be detected when perithecia are crushed in water and examined under the microscope. Paraphyses are lacking. Mature asci are cylindrical-clavate, 25–30 $\times$ 6–7 μ, and the ascospores tend to be biseriately arranged. The ascospores are hyaline, 1-septate, the upper cell being the broader. Ascospores, if measured a few minutes after expulsion, are 8–10 $\times$ 3.5–4.5 μ.

As indicated by the above mentioned characteristics of the ascigerous stage, this fungus manifestly belongs in the genus *Mycosphaerella* (*Sphaerella*). A search among previously described species of this genus revealed that in 1878 *Sphaerella nyssaecola* was described by Cooke (1) from specimens collected on *Nyssa multiflora,* in South Carolina, by H. W. Ravenel. Cooke's description (1) of *S. nyssaecola* is as follows: "Hypophylla. Peritheciis numerossisimis, semiimmersis, brunneis, punctiformibus. Ascis clavatis, Sporidiis minutis (immaturis). Ascis .02 — .025 mm." This description is manifestly very inadequate and it appeared desirable to make comparison with the type specimens, Ravenel's Fungi Americani, no. *96.* As a result of this comparison it was found that there is perfect agreement between the fungus under consideration, on *Nyssa,* and the type material of *S. nyssaecola.* In the light of the present observations it appears necessary to emend the description of this organism, and it is, therefore, briefly characterized as follows:

Mycosphaerella nyssaecola (Cooke) comb. nov.

Syn. *Sphaerella nyssaecola* Cooke, Hedwigia **17**: 40. 1878.
Sicc. Rav. Fungi Am. no. *96.*
Phyllosticta Nyssae Cooke, Grevillea **12**: 26. 1883.
Sicc. Rav. Fungi Am. no. *798*; Ellis N. Am. Fungi no. *1168.*

Perithecia hypophylla, numerosissima punctiformia, semiimmersa, brunnea, sphaerica, 60–85 μ diam.; asci cylindracei-clavati, aparaphysati, octospori, 25–30 × 6–7 μ; sporae vulgo distichae interdum inordinatae; inaequaliter 1-septatae, loculo superiore crassiore, constrictae, hyalinae, 8–10 × 3.5–4.5 μ.

Hab. in foliis dejectis *Nyssae sylvaticae, N. biflorae, N. aquaticae,* et *N. ogeche.*

Statum spermogonicum Phyllosticta nyssae sistit. Spermogoniis aestivo vel autumno in foliis adhuc vivis efformantis, hypophyllis. Maculis irregularibus, magnis, infra palladis, superiore purpureis. Spermogoniis punctiformibus, suberumpentibus, atris; spermatiis copiosis, bacilliformibus, 3–3.5 × 1.0–1.5 μ.

Specimens from the writer's collections have been deposited in each of the herbaria previously mentioned, where they are available to mycologists.

DISCUSSION

In the case of a few species of *Mycosphaerella* only, is it known at present that they lack conidia. The writer (**4**) recently called attention to one such fungus, *Mycosphaerella fraxinicola* (Schw.) House. The so-called conidial stage of this organism, *Phyllosticta viridis* Ellis & Kellerm., was found to be, in reality, a spermogonial stage. The developmental cycle of *M. fraxinicola* hence is entirely similar to that of the fungus under consideration in the present report. Many other at present detached species of conidial fungi, especially among those included in the form genus *Phyllosticta,* in the artificial group Bacillostictae (**3**) undoubtedly will be found to be spermogonial stages. The spores of most of them will probably be found incapable of functioning except as spermatia, although it is conceivable that some might function either as conidia or as spermatia. Among the reasons upon which this opinion is based is the observation that in certain species of fungi encountered, both conidia and spermatia may have the same origin and may be borne simultaneously within the same fructification.

It is well known that the genus *Mycosphaerella,* as delimited at present, contains approximately 1000 diverse species. Studies of life histories of representative species should provide a basis for cleavage of this large group into groups of naturally related species. The opinion may be ventured that none will be of greater phylogenetic interest than the group lacking conidia.

SUMMARY

The pathogen associated with a leafspot disease of several species of *Nyssa* has been commonly identified as *Phyllosticta Nyssae* Cooke. This organism appears to be limited in its distribution to the southeastern United States.

Lesions are evident during late summer when punctiform fructifications of the fungus are formed on the lower leaf surface. These fructifications, occurring singly, consist of interspersed spermogonia and perithecial primordia.

The spermogonial stage is identical with *Phyllosticta Nyssae*. By the following spring, the perithecial primordia will have become transformed into mature perithecia of *Mycosphaerella nyssaecola* (Cooke). Evidence of the presence of conidia in the developmental cycle of *M. nyssaecola* is lacking.

DUKE UNIVERSITY,
DURHAM, N. C.

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SOME FUNGI FROM GREECE

CONST. J. ALEXOPOULOS

(WITH 43 FIGURES)

There are comparatively few scientific publications which deal with the Greek mycoflora. Though extensive collections of Spermatophytes were made in Greece during the previous century and the beginnings of the present one, nothing seems to have been published in the way of descriptive mycology from that country before Politis (**6**) published his "Sulla Flora Micologica della Grecia" in 1911. Following this article, Politis has published a series of papers listing and describing fungi collected in different parts of Greece (**2, 3, 4, 5, 7, 8**).

In 1931, the Benaki Phytopathological Institute was established at Kephissia, near Athens, and Dr. J. A. Sarejanni, the plant pathologist at the institute, has since published two "Lists of Diseases" of native and cultivated plants of Greece. These are actually lists of pathogenic organisms occurring on different hosts. Early in 1939, Mr. C. Diapoulis (**1**) published a list of higher Basidiomycetes which he collected at Pelion.

In so far as could be determined, other publications dealing with Greek fungi are either phytopathological in nature, or deal with fungi causing human diseases. The fungi which cause diseases of economic plants in Greece are fairly well known, though many of them have not been systematically studied under conditions prevalent in that country. They have frequently been described in phytopathological literature and are often mentioned in popular agricultural pamphlets addressed to the farmers.

The present paper deals with a number of parasitic fungi collected by the writer in Greece from October 1938 to April 1939 while he was associated with the Institut de Chimie et d'Agriculture "Nicolaos Canellopoulos" at Piraeus. A few specimens are included which were sent to the writer's laboratory for identification and a few more which were collected in May 1937 by Palm and Alexopoulou.

Since illustrations of fungi collected in Greece are scarce in mycological literature, it was deemed advisable to illustrate many of the species herein reported even though some are by no means rare. Drawings, for the most part, were made with the aid of a camera lucida and the oil immersion objective. Spore measurements are recorded for most species and are in some cases compared with those given in the literature from other localities outside of Greece to bring out any ecological variations which were observed.

The specimens are deposited in the Mycological Herbarium of the Institut de Chimie et d'Agriculture " Nicolaos Canellopoulos " at Piraeus, Greece, and the numbers given here are those of the Institut. Citation in Saccardo's Sylloge Fungorum is given for each specimen and in the case of those previously reported from Greece, this is followed by the author and date of the Greek report. The Figure number following the bibliographical citations refers to the illustration in the present paper.

The writer wishes to thank Dr. K. Nevros, Director of the Institut de Chimie et d'Agriculture " Nicolaos Canellopoulos," for the excellent laboratory facilities placed at his disposal for this and other studies; the administrative authorities of Kent State University for extending to him a year's leave of absence for work in Greece; Dr. Jean C. Politis, Professor of Botany at the University of Athens, for identifying some of the host plants and for the use of the botanical library of the university; Mr. Foufas of the Department of Botany, University of Athens, and Mr. C. Diapoulis of the Hellenic Ministry of Agriculture for their assistance in various ways; Mr. V. Spanopoulos of the Institut de Chimie et d'Agriculture for his assistance in the preparation of the manuscript, and all others who in any way assisted. The writer is especially grateful to his sister Miss Theodora J. Alexopoulou for the preparation of the drawings.

ACTINOMYCETACEAE

1. ACTINOMYCES SCABIES (Thaxt.) Güssow, Bergey, Man. Det. Bact. 4th Ed., p. 507; Sarejanni, 1935.

Specimens of diseased potato tubers collected by Mr. J. Pavlakos at Kakourion, Mantineia, Nov. 16, 1938, and brought to the writer for identification of the causal organism. The organism is very

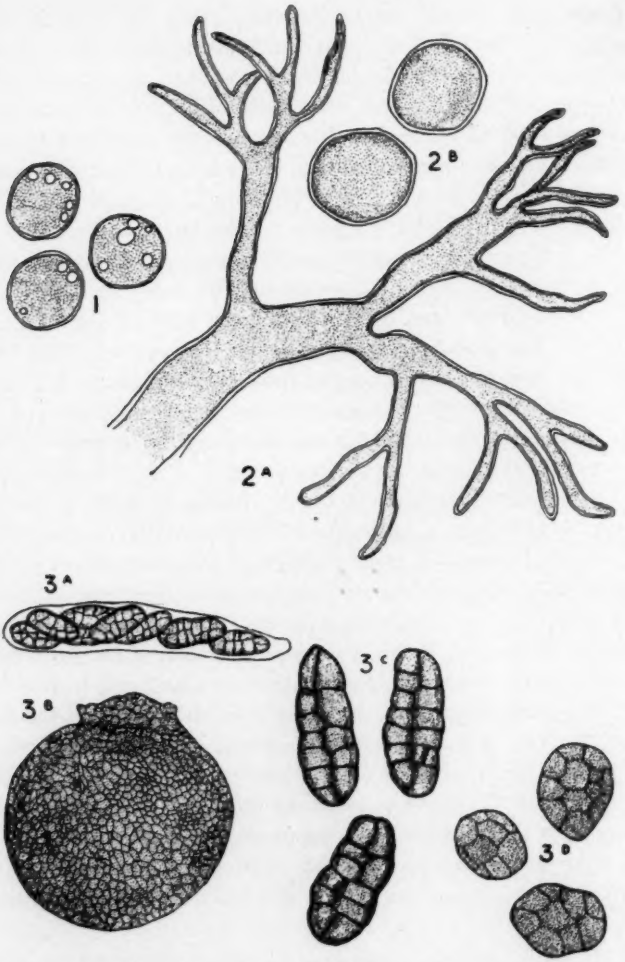

FIG. 1, *Albugo candida*, conidia (× 750); 2, *Peronospora parasitica*, *A*, conidiophore (× 750), *B*, conidia (× 750); 3, *Pleospora herbarum* f. *citrorum*, *A*, ascus (× 330), *B*, perithecium (× 135), *C*, ascospores (× 750), *D*, conidia from culture (× 750).

common and causes considerable damage in all potato growing sections of Greece (*No. 42*).

ALBUGINACEAE

2. ALBUGO CANDIDA (Pers.) Roussel. Sacc. Syll. Fung. **7**: 234; Sarejanni, 1935; *Cystopus candidus,* Politis, 1911. (FIG. 1.)

A common fungus on various crucifers. Collected on *Capsella Bursa-pastoris* L. at Argos, Argolis, Zervos farm, on March 15, 1939. The conidia measure 15–21 μ in diameter (*No. 57*).

PERONOSPORACEAE

3. PERONOSPORA PARASITICA (Pers.) DeBary, Sacc. Syll. Fung. **7**: 249; Politis, 1935; Sarejanni, 1935. (FIGS. 2*A*, 2*B*.)

Collected on *Capsella Bursa-pastoris* L. at Argos, Argolis, Zervos farm, on March 15, 1939. Conidia measure 18–29.2 $\times$ 15.5–26.5 μ (*No. 56*).

HYPODERMATACEAE

4. LOPHODERMIUM PINASTRI (Schrad.) Chev. Sacc. Syll. Fung. **2**: 794. (FIGS. 4*A*, 4*B*.)

The few infected dry leaves of *Pinus halepensis* Mill. in this specimen were collected on Oct. 30, 1938, at Rema Loverthou, near Kephissia, Attica (*No. 31*). The asci measure 96–114.5 $\times$ 11.5–12.5 μ and the ascospores, 78–86 $\times$ 1.5 μ. Stevens (Fungi which cause plant disease, p. 162) records 90–120 μ for the length of the ascospores of this species. The fungus has not been previously reported from Greece.

MOLLISIACEAE

5. PSEUDOPEZIZA MEDICAGINIS (Lib.) Sacc. Syll. Fung. **8**: 724. (FIG. 5.)

A collection from Vouliagmeni, Attica, made in May 1937 by Palm and Alexopoulou. The fungus is on diseased leaves of *Lotus corniculatus* L. and apothecia are abundant on the upper surface of the leaf, a few also being found on the lower surface. In the specimen (*No. 47*) the asci measure 80–91 $\times$ 8.5–10.5 μ and the ascospores, 8–13 $\times$ 3.5–4.5 μ.

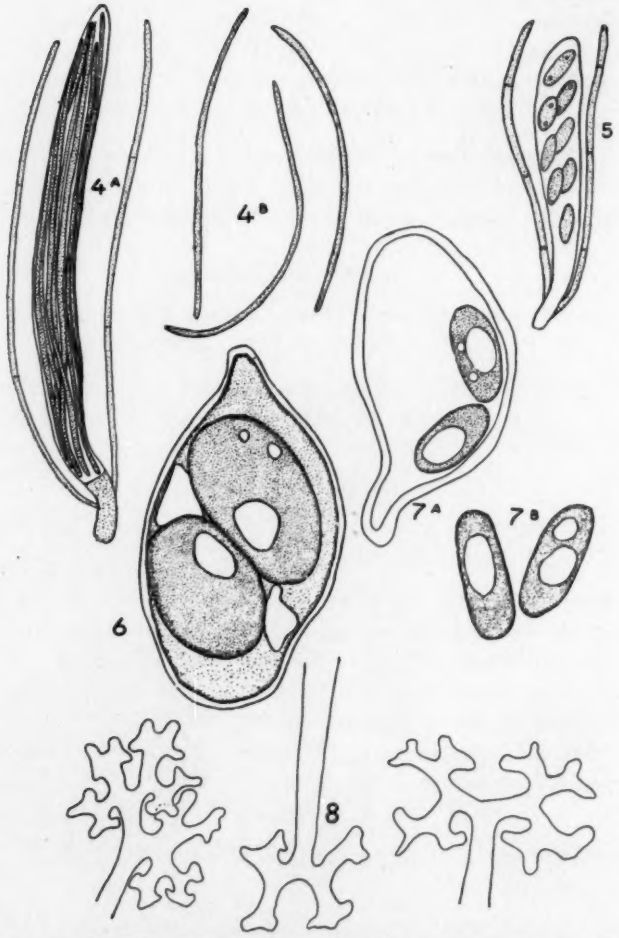

FIG. 4, *Lophodermium Pinastri, A,* asci with ascospores and paraphyses, *B,* ascospores; 5, *Pseudopeziza Medicaginis,* ascus with ascospores and paraphyses; 6, *Phyllactinia corylea,* ascus with ascospores; 7, *Erysiphe Polygoni, A,* ascus, *B,* ascospores; 8, *Microsphaera Alni* var. *extensa,* appendage tips. All × 750.

Microtome sections revealed the presence of pycnidia embedded in the leaf tissue, scattered among the apothecia. These pycnidia contain minute, bacillary pycnidiospores reminiscent of spermatia. Stevens (Ibid, p. 148) mentions that a *Phyllosticta* is thought to be the conidial stage of *Pseudopeziza Medicaginis*.

This seems to be the first report of this fungus from Greece. The same fungus was collected by the writer at Mycenae, Argolis, on *Trifolium procumbens* var. *minus*, on March 14, 1939 (*No. 82*).

ERYSIPHACEAE

6. ERYSIPHE POLYGONI D.C. Salm. Monogr. Erysiph. p. 174; Politis, 1935; Sarejanni, 1935; *E. communis* Sacc. Syll. Fung. 1: 18. (FIGS. 7*A*, 7*B*.)

Collected on *Polygonum lapathifolium* L. at Florina in Macedonia (*No. 6*), Sept. 30, 1938, and on *Polygonum aviculare* L. at Bafi, Attica (*No. 20*), Oct. 25, 1938. Most of the perithecia on the Macedonian specimen were immature at the time of collection. The dimensions of the fungus taken from *P. aviculare* fall well within the limits given by Salmon. They are: Perithecia, 163–186 μ; asci, 61–70 $\times$ 41–44 μ; ascospores, 23.5–28.5 $\times$ 10.5–11.5 μ. There are from 3 to 8 asci in each perithecium, each ascus usually containing 3 or 4 spores, but the number of spores varying from 2 (FIG. 7*A*) to 5.

7. MICROSPHAERA ALNI (Wallr.) Salm. Monogr. Erysiph. p. 129. (FIG. 8.)

This specimen (*No. 12*) collected at Kato Kleinai, Florina, on Sept. 20, 1938, consists of several leaves of *Quercus lanuginosa* Thuill., heavily infected with mycelium on which perithecia are very abundant. *Oidium alphitoides* G. & M., which may be the imperfect stage of this fungus, has been reported by Sarejanni (**9**) on *Quercus coccifera* L. from Greece, but the perithecial stage does not seem to have been reported in the literature from that country. The perithecia from the specimen on hand measure 114–145 μ; the asci, 48–65 μ, and the ascospores, 20–26 $\times$ 13–13.5 μ.

8. PHYLLACTINIA CORYLEA (Pers.) Karst. Salm. Monogr. Erysiph. p. 224; *P. suffulta* (Reb.) Sacc. Syll. Fung. **1**: 5; Politis, 1935. (FIG. 6.)

Collected at Xylocastron, Corinthia, on March 20, 1939, on bark of *Pyrus communis* L. (*No. 64*). *P. suffulta* which Salmon considers synonymous with *P. corylea* has been reported from Attica on *Lonicera caprifolium* L. by Politis (**4**). Measurements from the specimen on hand are: Perithecia, 182–197.5 μ; asci, 67–75.5 $\times$ 30–39 μ; ascospores, 36–39 $\times$ 18–22.5 μ. These figures agree with those given by Salmon in his description of this species.

PLEOSPORACEAE

9. PLEOSPORA HERBARUM (Pers.) Rabh. f. *citrorum* Sacc. Syll. Fung. **2**: 247. (FIGS. 3*A*, 3*B*, 3*C*, 3*D*.)

Specimens of diseased lemon twigs, collected at Gargalianoi, Trifyllia, were brought to the writer's laboratory for diagnosis by Mr. P. Papademetriou in November 1938. Among other fungi, *Pleospora herbarum f. citrorum* was found on the dried tips which had turned a characteristic grayish-white color. The perithecia of the fungus had been abundantly formed and many of them contained mature asci and ascospores. The perithecia averaged 260 μ in diameter. Asci measured 91–127.5 $\times$ 24–30 μ; ascospores, 23.5–46 $\times$ 9–18 μ. These figures compare well with those given in Saccardo's description.

The fungus was taken in culture, and perithecia with asci and spores were obtained in certain media. In addition to the perithecia and much before they were developed, the fungus produced an abundance of the *Macrosporium* type conidia (FIG. 3*D*) which measured 15.5–23.5 $\times$ 13–15.5 μ (*No. 40*).

COLEOSPORIACEAE

10. COLEOSPORIUM INULAE (Kunze) Ed. Fisch. Sacc. Syll. Fung. **21**: 721; Politis, 1935.

The uredospores of this fungus were collected by Palm and Alexopoulou on leaves of *Inula attica* L. in May 1937, at Vouliagmeni Attica (*No. 49*) and by the writer on the same host on

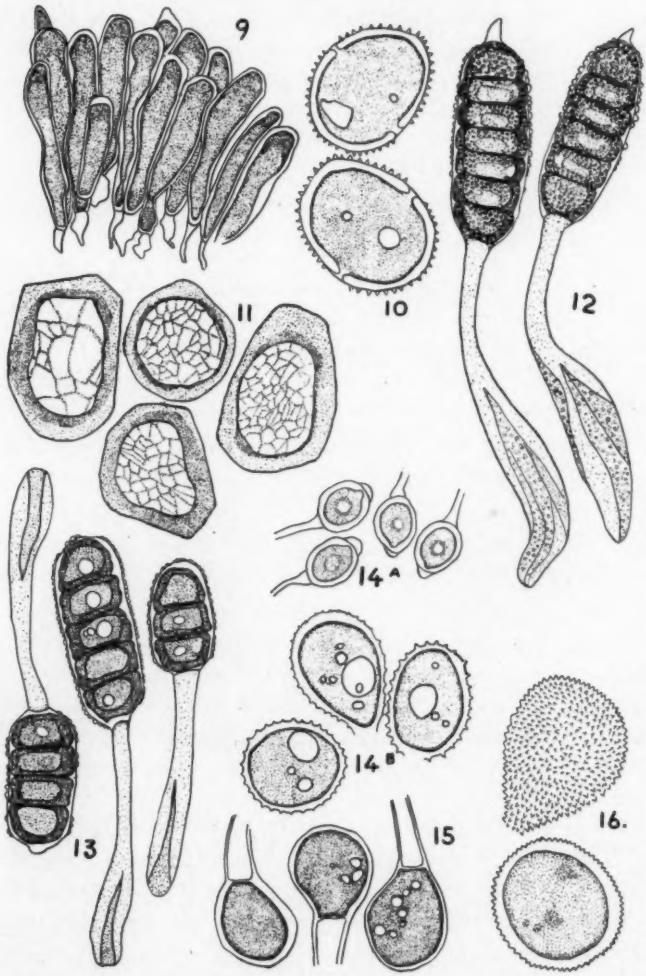

FIG. 9, *Coleosporium Tussilaginis*, teleutospores (× 330); 10, *Uromyces Fabae*, uredospores (× 750); 11, *Gymnosporangium Sabinae*, aeciospores (× 750); 12, *Phragmidium subcorticium*, teleutospores (× 750); 13, *Phragmidium violaceum*, teleutospores (× 750); 14, *Uromyces appendiculatus*, *A*, teleutospores (× 330); *B*, uredospores (× 750); 15, *Uromyces Scillarum*, teleutospores (× 750); 16, *Uromyces Limonii*, uredospores (× 750).

Nov. 5, 1938, at Daphni, Attica (*No. 38*). They were found to measure 20.5–35 × 16–23.5 μ being somewhat larger than recorded by Saccardo. The teleutospores were found on leaves of *Inula viscosa* (L) Ait. at Rema Loverthou, near Kephissia, Attica, on Oct. 30, 1938 (*No. 28*). The teleutospores measure 50–96 × 22–28.5 μ as compared to 100 × 18–24 μ given by Saccardo.

11. COLEOSPORIUM TUSSILAGINIS Tul., Grove, British Rust Fungi, p. 322; Politis, 1938. (FIG. 9.)

Though this fungus is rather common on leaves of *Tussilago farfara* L., it has only recently been reported from Greece. The specimens in the present collection were taken at Bafi, Attica, on Oct. 25, 1938 (*No. 22*), and at Rema Loverthou, near Kephissia, Attica, five days later (*No. 29*). The teleutospores are up to 130 μ in length and 19–34 μ in breadth.

MELAMPSORACEAE

12. MELAMPSORA EUPHORBIAE Cast. Grove, British Rust Fungi, p. 353; *M. Helioscopiae* Wint. Sacc. Syll. Fung. **7**: 586; Politis, 1911; Sarejanni, 1935.

The uredo stage was collected on March 19, 1939, at Pyrgos, Eleia, on the grounds of the A. S. O. Currant Institute, on *Euphorbia helioscopia* L. (*No. 62*). The uredospores measure 15.5–23.5 × 14–18 μ, being somewhat larger in diameter than those reported by Grove. The hyaline paraphyses scattered among the uredospores measure 13–18.5 μ diam. A scant collection of teleutospore material was made in May 1937 by Palm and Alexopoulou at Vouliagmeni, Attica, on an undetermined species of *Euphorbia* (*No. 48*). The teleutospores measure 41.5–62.5 × 11–14.5 μ, closely approximating in size those reported by Grove as 50–60 × 10–14 μ.

PUCCINIACEAE

13. PHRAGMIDIUM SUBCORTICIUM (Schr.) Wint. Sacc. Syll. Fung. **7**: 746; Politis, 1935. (FIG. 12.)

A collection of leaves of cultivated *Rosa* taken in the Lakon garden at Kephissia, Attica, on Oct. 30, 1938 (*No. 32*). Measure-

ments are as follows: Uredospores, 24–31 × 18–22 μ; teleutospores, 63–95 × 30–36 μ. These compare well with those given by Grove (British Rust Fungi p. 293) for *Phragmidium disciflorum* James of which he considers *P. subcorticium* a synonym.

14. PHRAGMIDIUM VIOLACEUM (Schultz.) Wint. Grove, British Rust Fungi, p. 295; Sacc. Syll. Fung. **7**: 744; Politis, 1935. (FIG. 13.)

Teleutospores were abundant on leaves of *Rubus ulmifolius* Schott. collected at Florina on Sept. 30, 1938 (*No. 11*), and at Bafi, Attica, on Oct. 25, 1938 (*No. 23*). They measure 41.5–116.5 × 34–44 μ. Politis reports this fungus from Attica on *Rubus fructicosus*.

15. GYMNOSPORANGIUM SABINAE (Dicks.) Wint. Grove, British Rust Fungi, p. 308; Sacc. Syll. Fung. **7**: 739; Politis, 1935; *Roestelia cancellata* Reb., Sarejanni, 1935. (FIG. 11.)

A very common fungus causing considerable damage to pear trees in all parts of Greece. The *Roestelia* stage, which has been reported from Greece by Sarejanni, and others was collected on leaves of *Pyrus communis* L. at Thessaloniki, in the University Experimental Orchards on Sept. 27, 1938 (*No. 5*), and again at Florina in the orchards of the Florina Agricultural School, three days later (*No. 8*). Aeciospores from the Florina specimen measure 26–38 × 18–27.5 μ.

16. UROMYCES APPENDICULATUS (Pers.) Link., Sacc. Syll. Fung. **7**: 535; Sarejanni, 1935; Politis, 1938. (FIGS. 14*A*, 14*B*.)

This fungus is found wherever beans are grown in Greece. Both uredo and telial stages were found when these specimens were collected, the teliosori being much more abundant. The first collection was made on Sept. 30, 1938, in the gardens of the Florina Agricultural School in Florina (*No. 9*), and the second on Oct. 25, 1938, at Bafi, Attica (*No. 24*). Measurements: Uredospores, 21.5–31.5 × 17–22; teleutospores, 28–35 × 21–26 μ. On leaves of *Phaseolus vulgaris* L.

17. UROMYCES FABAE (Pers.) DeBary, Grove, British Rust Fungi, p. 97; Sacc. Syll. Fung. **7**: 531; Politis, 1911; Sarejanni, 1935. (FIG. 10.)

Very common in all parts of Greece. Specimens were collected at Salamis by Mr. P. Papademetriou, on Feb. 13, 1939 (*No. 83*), and by the writer at Thouria, Kalamai, March 17, 1939 (*No. 59*), and at Katerini, Macedonia, June 6, 1939 (*No. 84*). The last of these collections consisted of both uredo and telial stages. Spore measurements are: Uredospores, 23.5–32.5 × 18–26 μ; teleutospores, 31–43 × 20–25.5 μ.

18. UROMYCES JUNCI (Desm.) Tul. Grove, British Rust Fungi, p. 123; Sacc. Syll. **7**: 541. (FIG. 18.)

A scant collection of teleutospores from Kephissia, Attica, taken at Rema Loverthou, on *Juncus* sp., on Oct. 30, 1938 (*No. 30*). Teleutospores measure 23.5–37 × 15.5–21 μ. This is the first report of this fungus from Greece.

19. UROMYCES LIMONII (D.C.) Lev. Grove, British Rust Fungi, p. 88; Sacc. Syll. Fung. **7**: 532. (FIG. 16.)

A collection of uredospores on *Limonium sinuatum* Mill. taken by Palm and Alexopoulou at Vouliagmeni, Attica, in May 1937 (*No. 50*). Uredospores measure 26–26.5 × 25.5–30 μ. This is the first report of this fungus from Greece.

20. UROMYCES SCILLARUM (Grev.) Wint. Grove, British Rust Fungi, p. 120; Sacc. Syll. Fung. **7**: 567; Politis, 1935. (FIG. 15.)

A scant collection taken at Mycenae, Argolis, on March 14, 1939, on leaves of *Muscari botryoides* Mill. (*No. 54*). Teleutospores measure 18–28.5 × 15.5–20 μ. Politis has reported this fungus from Greece on *Muscari comosum* Mill.

21. PUCCINIA ALLII (D.C.) Rud. Sacc. Syll. Fung. **7**: 655; Politis, 1911; Sarejanni, 1935. (FIGS. 20*A*, 20*B*.)

Collected at Thouria, Kalamai on March 17, 1939 (*No. 61*), on leaves of *Allium sativum* L. Uredospores were most prevalent,

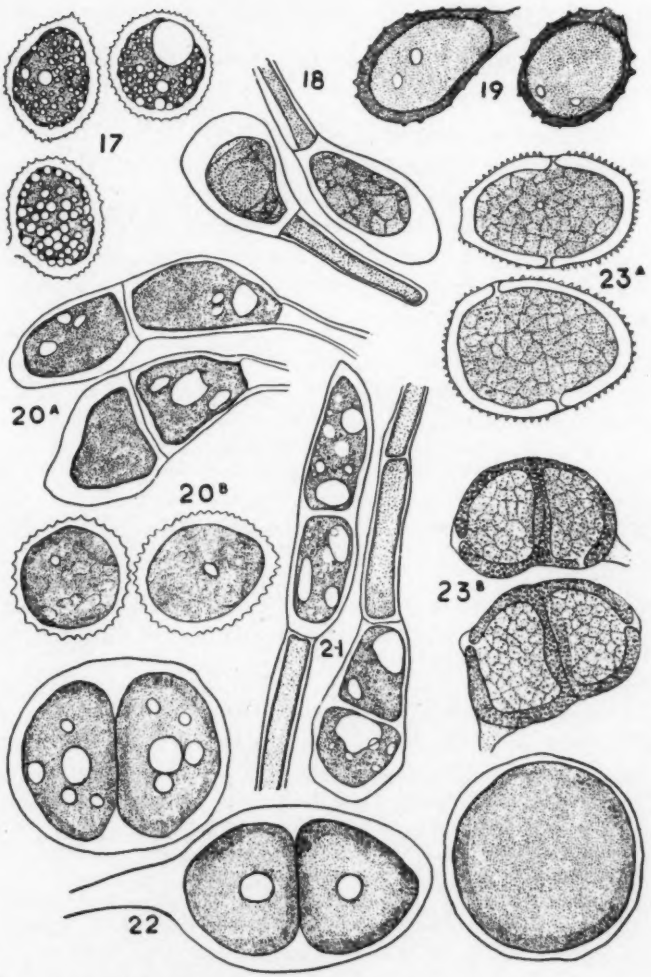

FIG. 17, *Puccinia glumarum*, uredospores; 18, *Uromyces Junci*, teleutospores; 19, *Puccinia Polygoni-amphibii*, uredospores; 20, *Puccinia Allii*, *A*, teleutospores, *B*, uredospores; 21, *Puccinia Malvaceaarum*, teleutospores; 22, *Puccinia Asphodelii*, teleutospores; 23, *Puccinia Vincae*, *A*, uredospores, *B*, teleutospores. All × 750.

but some teleutospores were also mature. Uredospores measure 20.1–33.5 × 15.5–28.5 μ and teleutospores, 41.5–57.5 × 19.5–26 μ.

22. PUCCINIA ASPHODELII Daby. Sacc. Syll. Fung. **7**: 666; Politis, 1911. (FIG. 22.)

This fungus seems to be as common in Greece as its host. It was collected on Lykabettus Hill in Athens on March 9, 1939 (*No. 52*), by the writer, and at Koressia, Kea, on April 21, 1939 (*No. 66*), by Alexopoulou, on *Asphodelus microcarpus* Reichb. The latter specimen bears both uredospores and teleutospores. Measurements are: Uredospores, 28.5–52 × 20.5–28.5 μ; teleutospores, 44–72 × 33.5–52 μ.

23. PUCCINIA GLUMARUM (Schm.) Er. & Henn. Grove, British Rust Fungi, p. 258; Sacc. Syll. Fung. **17**: 380; Politis, 1929; Sarejanni, 1935. (FIG. 17.)

Leaves of *Triticum vulgare* L. collected on March 17, 1939, at Sperchogia, Kalamai (*No. 60*), were heavily infected with the uredo stage of *P. glumarum*. Uredospores measure 20.5–28.5 × 18–23.5 μ.

24. PUCCINIA MALVACEARUM Mont., Grove, British Rust Fungi, p. 206; Sacc. Syll. Fung. **7**: 686; Politis, 1911; Sarejanni, 1935. (FIG. 21.)

This fungus is widely distributed in Greece on a number of Malvaceous hosts. It was collected in December 1938 at Agia Paraskevi, Attica (*No. 46*), on leaves of *Althea rosea* L., and on February 27, 1939, back of the Institut at Drapetsona, Piraeus, on leaves of *Malva rotundifolia* L. (*No. 51*). Teleutospores, 41–68 × 15.5–26 μ.

25. PUCCINIA POLYGONI-AMPHIBII Schroet. Grove, British Rust Fungi, p. 227. (FIG. 19.)

This specimen was collected at Argos, Argolis, Zervos farm, on March 15, 1939 (*No. 58*). Only one leaf of *Polygonum amphibium* L. was found to be infected; it bore a considerable number of uredinia. The uredospores measure 23.5–28.5 × 21–26 μ. They are thus, somewhat greater in diameter than those recorded

by Grove who gives 25–28 × 18–21 μ as measurements for this species. No teleutospores were found.

26. PUCCINIA VINCAE (D.C.) Plowright. Grove, British Rust Fungi, p. 176; Sacc. Syll. Fung. **9**: 310; Politis, 1935; Sarejanni, 1935. (FIGS. 23*A*, 23*B*.)

A rather common fungus on *Vinca major* L. collected at the Lakon garden, in Kephissia, Attica, on Oct. 30, 1938 (*No. 34*). Teleutospores measure 32.5–45.5 × 23.5–28 μ.

SPHAERIOIDACEAE

27. PHOMA NEBULOSA (Pers.) Mont. Grove, British Stem & Leaf Fungi **1**: 62; Sacc. Syll. Fung. **3**: 135. (FIG. 25.)

This is the first report of this fungus from Greece. It was collected at Athens on Lykabettus Hill, on Dec. 11, 1938, on dried peduncles of *Asphodelus microcarpus* Reichb. (*No. 43*). Conidia, 8–10.5 × 3–4.5 μ.

28. PHOMA VITICIS Celotti. Sacc. Syll. Fung. **10**: 155; Politis, 1935.

A collection from Daphni, Attica, on leaves of *Vitex agnus-castus* L., taken on Nov. 5, 1938. The conidia from this specimen measure 6.5–10.5 × 2.5–5.5 μ as compared with 6–8 × 2–3 μ given by Saccardo for this species. The pycnidia are small and are brown instead of black as stated by Saccardo. Neither these differences, nor the fact that this was found on leaves, are considered by the writer as sufficient causes to separate this fungus from *Phoma Viticis*.

29. SEPTORIA PIRICOLA Desm. Grove, British Stem & Leaf Fungi **1**: 400; Sacc. Syll. Fung. **3**: 487; Politis, 1935. (FIG. 27.)

The conidial stage of *Mycosphaerella sentina* (Fries) Schr. commonly found in all pear growing districts of Greece causing considerable amount of damage to the leaves of pear trees. A collection was made at Argos, Argolis, on Sept. 19, 1938 (*No. 2*), and at Assini, Nauplia on the following day (*No. 3*). The conidia measure 34–58 × 3–4.5 μ, thus exhibiting a greater variation than that reported by Grove (48–60 × 3–4 μ).

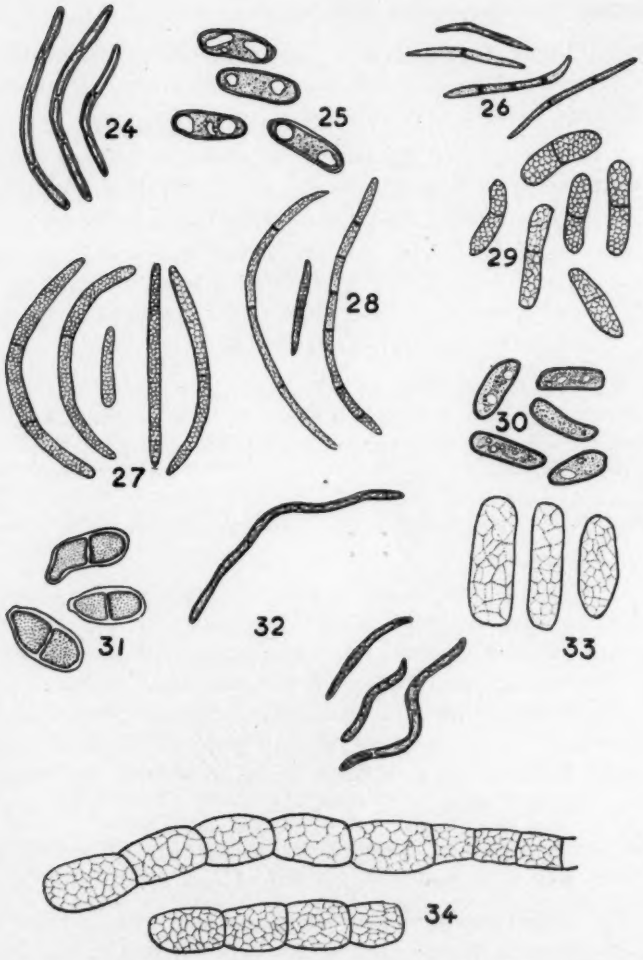

FIG. 24, *Septoria pistacina*, conidia; 25, *Phoma nebulosa*, conidia; 26, *Septoria Urticae*, conidia; 27, *Septoria piricola*, conidia; 28, *Septoria Tritici*, conidia; 29, *Ascochyta Pisi*, conidia; 30, *Colletotrichum glocosporioides*, conidia; 31, *Trichothecium roseum*, conidia; 32, *Septoria Unedonis*, conidia; 33, *Oidium Euonymi-japonici*, conidia; 34, *Oidium leucoconium*, chains of conidia and portion of conidiophore. All × 750.

30. SEPTORIA PISTACINA Allesch. Sacc. Syll. Fung. **16**: 959; Politis, 1935; Sarajanni, 1935. (FIG. 24.)

This fungus, reported both by Politis and Sarejanni as occurring in Greece on *Pistacia vera* L. was collected by the writer on Oct. 16, 1938, on leaves of *Pistacia terebinthus* L., on Mt. Penteli, Attica (*No. 15*), and on leaves of a male tree of *P. vera* L., at Ekale, Attica, on Oct. 21, 1938 (*No. 18*). The conidia measure 26–52 × 1.5 μ.

31. SEPTORIA TRITICI Rob. & Desm. Grove, British Stem & Leaf Fungi **1**: 423; Sacc. Syll. Fung. **3**: 561. (FIG. 28.)

Specimens of diseased wheat plants were sent to the writer's laboratory at Piraeus for diagnosis of the disease, from Keramathika, Tyrnavos, Larissa. The sender claimed from 15 per cent to 25 per cent damage caused by this disease in the field in which these specimens were collected on March 24, 1939. The causal fungus was determined as *Septoria Tritici* (*No. 65*).

The conidia which are mostly 3-septate, measure 46–66.5 × 1–1.5 μ. Grove gives 60–65 × 3.5–5 μ as dimensions for the conidia of this fungus. He states, however, that "Cavara gives the typical spores of *S. Tritici* as 50–60 × 1.5–2 μ. . . ." Neither Politis nor Sarejanni list this fungus as having been found by them in Greece. Sarejanni (Ann. Inst. Phytopath. Benaki **1**, No. 2, p. 19, 1935) lists *S. graminum* on *Triticum* sp. from Greece. The measurements of the spores of the latter species, according to Grove (**1**: 421) are 45–75 × 1–1.5 μ. This would fit the specimen on hand, but the spores of *S. graminum* are supposed to be aseptate or "rarely with a few indistinct septa" (Grove) while those of the specimen under discussion are distinctly septate. Because of this fact, it is believed that we are dealing with *S. Tritici* in the present case.

32. SEPTORIA UNEDONIS Rob. & Desm. Grove, British Stem & Leaf Fungi **1**: 369; Sacc. Syll. Fung. **3**: 493; Sarejanni, 1935; Politis, 1938. (FIG. 32.)

Infected leaves of *Arbutus unedo* L. were collected on Mt. Penteli, Attica, on Oct. 16, 1938 (*No. 16*), and again at Bafi, Attica, on Oct. 25, 1938 (*No. 21*). The spores measure 17.5–

35 × 1.5–2 μ. This species is apparently very variable in the size of its spores. Grove (**1**: 369) gives 25–30 × 1.5–2 μ as measurements from a British specimen and 25–63 × 2–3 μ from a Cyprian specimen.

Sarejanni (Ann. Inst. Phytopath. Benaki **1**, No. 2, p. 13, 1935) reports *S. Unedonis* Rob. var. *vellanensis* Br. & Cav., as occurring on *Arbutus unedo* × *andrachne* Bois, in Greece, and Politis (Pragm. Acad. Athènes, **3**, No. 4, p. 33, 1935), describes a new species, *S. andrachnes* Pol., from *Arbutus andrachne* L., the conidia of which measure 30–40 × 1–1.5 μ. From the description given, it would appear that there is little difference between it and *S. Unedonis* and that the two are probably synonymous.

33. SEPTORIA URTICAE Desm. & Rob. Grove, British Stem & Leaf Fungi **1**: 413; Sacc. Syll. Fung. **3**: 557; Politis, 1935. (FIG. 26.)

Collected at Argos, Argolis, near the ancient theatre, on *Urtica pilulifera* (*No. 55*). The pycnidia measure 65–111 μ in diameter. Conidia, 30–50.5 × 1–1.5 μ. Politis reports this species from Attica on leaves of *Urtica urens*. The spore measurements agree with those given by Grove.

34. ASCOCHYTA PISI Lib. Grove, British Stem & Leaf Fungi **1**: 309; Sacc. Syll. Fung. **3**: 397; Politis, 1935; Sarejanni, 1935. (FIG. 29.)

Leaves of *Vicia faba* L. infected with this fungus were brought to the writer's laboratory for diagnosis from Helleniko, Attica, in January 1939 (*No. 45*). Conidia, 11–27.5 × 4.5–6.5 μ.

35. CONIOTHYRIUM CONCENTRICUM (Desm.) Sacc. Grove, British Stem & Leaf Fungi **2**: 14; Sacc. Syll. Fung. **3**: 317; Sarejanni, 1935. (FIG. 39.)

This collection (*No. 13*) was made on Oct. 16, 1938. Sections of infected leaves of *Agave americana* L. growing by the side of the road leading from Amaroussion, Attica, to Mt. Penteli, were found to bear the pycnidia of this fungus. The conidia measure 5–6.5 × 5 μ.

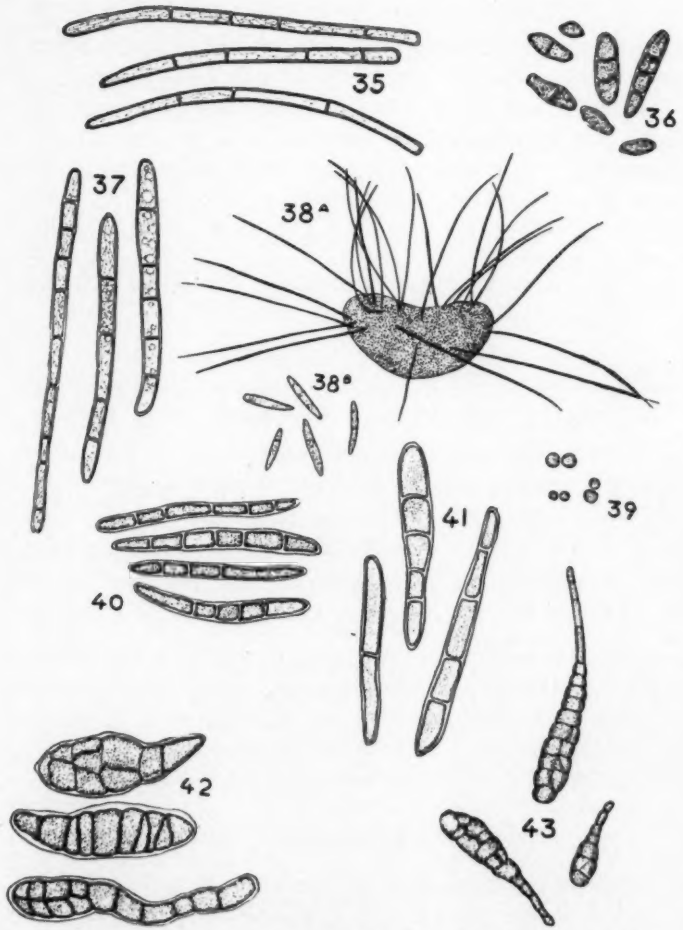

FIG. 35, *Cercospora myrticola*, conidia; 36, *Cladosporium herbarum*, conidia; 37, *Cercospora smilacina*, conidia; 38, *Chaetomella atra*, *A*, pycnidium, *B*, conidia; 39, *Coniothyrium concentricum*, conidia; 40, *Cercospora neriella*, conidia; 41, *Cercospora Capparidis*, conidia; 42, *Macrosporium Vitis*, conidia; 43, *Alternaria Brassicae*, conidia. Fig. 38 *A*, × 75, all others × 750.

36. CHAETOMELLA ATRA Fuckel, Sacc. Syll. Fung. **3**: 321. (FIGS. 38*A*, 38*B*.)

Dried pedicels of *Papaver rhoeas* L. collected on Lykabettus Hill in Athens on Dec. 11, 1938, were found to bear pycnidia of *Chaetomella atra* Fuckel. The pycnidiospores measure 13–15 × 3 μ. The pycnidia are either sphaerical or of the shope shown in figure 38*A*. This is the first report of the fungus from Greece (*No. 44*).

ZYTHIACEAE

37. POLYSTIGMINA RUBRA Sacc. Grove, British Stem & Leaf Fungi **2**: 121; Sacc. Syll. Fung. **3**: 622.

This is the imperfect stage of *Polystigma rubra* (Pers.) D.C., collected on leaves of *Amygdalus communis* L., on Mt. Penteli, Attica, Oct. 16, 1938 (*No. 14*). The conidia average 24 × 1.5 μ. Sarejanni (Ann. Inst. Phytopath. Benaki **1**, No. 2, p. 17, 1935) reports *Polystigma ochraceum* Sacc. on almond, in Greece.

MELANCONIACEAE

38. COLLETOTRICHUM GLOEOSPORIOIDES Penz. Sacc. Syll. Fung. **3**: 735; Politis, 1935, Sarejanni, 1935. (FIG. 30.)

Commonly found in all Citrus growing sections of Greece as the cause of withertip and as a secondary parasite, following other pathogens. This specimen (*No. 41*) was collected at Gargalianoi, Trifyllia in September 1938 by Mr. Papademetriou, on *Citrus sinensis* Osb. The conidia measure 13–18.5 × 5–7 μ.

MONILIACEAE

39. OIDIUM EUONYMI-JAPONICI (Archang.) Sacc. Syll. Fung. **18**: 506; Politis, 1935; Sarejanni, 1936. (FIG. 33.)

Widely distributed as a parasite of *Evonymus japonicus* L. which is commonly used as an ornamental throughout Greece. The present specimen (*No. 1*) was collected at Kephissia, Attica, on Sept. 10, 1938. The conidia measure 21.5–34.5 × 9.5–15.5 μ. Saccardo gives 30–38 × 13–14 μ as conidial dimensions.

40. OIDIUM LEUCOCONIUM Desm. Sacc. Syll. Fung. **4**: 41; Politis, 1935; Sarejanni, 1935. (FIG. 34.)

This fungus which causes considerable damage to peaches and roses, is quite common in Greece. It has been reported by Politis from rose and by Sarejanni from peach. The specimens on hand consist of infected peach leaves and young stems (*No. 7*) collected on Sept. 30, 1938, in the orchards of the Florina Agricultural School in Florina, and of infected leaves of Rosa sp. (*No. 39*) collected near Psychico, Attica, on Nov. 13, 1938. The conidia from peach leaves measure 18–21 × 8–13 μ. These dimensions are smaller than 20–30 × 13–16 μ, given by Saccardo for the same fungus.

41. OIDIUM MONILIOIDES Link. Sacc. Syll. Fung. **4**: 46; Politis, 1935; *Erysiphe graminis* D.C., Politis, 1935; Sarejanni, 1935.

Collected at Argos, Argolis, near the ancient theatre, on *Triticum vulgare* L. (*No. 53*). The conidia, found in abundance, measure 28–36.5 × 8.5–13 μ. Many perithecia, undoubtedly of *Erysiphe graminis* of which this is the conidial stage, had been formed at the time of collection, but none were mature. Both stages have been reported from Greece by Politis.

42. BOTRYTIS CINEREA Pers. Sacc. Syll. Fung. **4**: 129; Politis, 1935; Sarejanni, 1935.

A collection from the Athanasopoulos vineyard at Ekale, Attica, where it was found to cause considerable damage to mature grape berries, taken on Oct. 21, 1938 (*No. 17*). Measurements for the conidia on fruits of *Vitis vinifera* L., 8.5–17 × 8–11 μ.

43. TRICHOTHECIUM ROSEUM (Pers.) Link. Sacc. Syll. Fung. **4**: 178; Politis, 1935; Sarejanni, 1935. (FIG. 31.)

On leaves of *Vitis vinifera* L. collected at Gargalianoi, Trifyllia, on Oct. 25, 1938 (*No. 19*), and sent to the writer's laboratory. Conidia, 15.5–24 × 8.5–11 μ.

DEMATIACEAE

44. CLADOSPORIUM HERBARUM (Pers.) Link. Sacc. Syll. Fung. **4**: 350; Politis, 1935; Sarejanni, 1935. (FIG. 36.)

A very common saprophyte. On scorched leaves of *Pistachia lentiscus* L., collected at Rema Loverthou, Kephissia, Attica, on Oct. 30, 1938 (*No. 26*). Conidia, 5.5–19.5 × 3.5–5 μ.

45. MACROSPORIUM VITIS Sorok. Sacc. Syll. Fung. **11**: 635. (FIG. 42.)

This fungus, new to Greece, was found on diseased mature berries of *Vitis vinifera* L. on Nov. 9, 1938, at Bafi, Attica (*No. 85*). There is a large variation in the size of the conidia which were found to measure 17–58.5 × 10.5–18 μ. Saccardo records 28–30 × 15 μ for this species.

46. ALTERNARIA BRASSICAE (Berk.) Sacc. Syll. Fung. **4**: 546; Politis, 1935. (FIG. 43.)

This fungus, reported from Greece by Politis on leaves of *Brassica oleracea* L., was collected on leaves of *Phaseolus vulgaris* L., on Sept. 21, 1938, at Agios Vasileios, Corinthia (*No. 4*), and on Sept. 30, 1938, at Florina, Macedonia (*No. 10*). A very large variation in the size of the conidia was observed, the measurements being 42–121 × 11–15.5 μ as compared to 60–80 × 14–18 μ given by Saccardo.

47. CERCOSPORA CAPPARIDIS Sacc. Syll. Fung. **4**: 435; Politis, 1935. (FIG. 41.)

Collected at Daphni, Attica, on Nov. 5, 1938, on leaves of *Capparis spinosa* L. (*No. 36*). The conidia measure 26–82.5 × 5–6.5 μ and vary in septation from continuous to 8-septate.

48. CERCOSPORA MYRTICOLA Speg. Sacc. Syll. Fung. **10**: 643; *C. myrti* Erikss., Politis, 1935. (FIG. 35.)

Collected on Oct. 16, 1938, on Mt. Penteli, Attica, on leaves of *Myrtus communis* L. The conidia measure 56–101.5 × 3–5.5 μ. The fungus was kindly identified by Prof. C. C. Chupp of Cornell University, to whom the writer is grateful.

49. CERCOSPORA NERIELLA Sacc. Syll. Fung. **4**: 473. (FIG. 40.)

Leaves of plants of *Nerium Oleander* L. growing wild at the bottom of a ravine at Rema Loverthou, near Kephissia, Attica, were found to be infected by this fungus (*No. 27*). The fructification appears on the upper side of the leaves on definitely limited spots, brownish when young, turning grayish white with age, and limited by a brown margin, in turn surrounded by an area of yellow discoloration of the adjoining leaf tissue. The conidiophores arise in stromatic masses which appear more or less globose under the binocular. The conidia are septate and vary greatly in size, 26.5–70 × 3.5–5 μ. This very interesting fungus is for the first time being reported from Greece.

50. CERCOSPORA SMILACINA Sacc. Syll. Fung. **4**: 476; Politis, 1911. (FIG. 37.)

A large number of leaves of *Smilax aspera* L. were found to be infected by this fungus. This specimen (*No. 25*) was collected at Rema Loverthou, near Kephissia, Attica, on Oct. 30, 1938. The fungus has also been observed by the writer in many other places in Greece where *Smilax aspera* grows abundantly.

PHYTOPATHOLOGICAL LABORATORIES,
INSTITUT DE CHIMIE ET D'AGRICULTURE "NICOLAOS CANELLOPOULOS,"
DRAPETSONA, PIRAEUS,
GREECE

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UREDINALES OF NEW GUINEA[1]

GEORGE B. CUMMINS[2]

(WITH 14 FIGURES)

The 34 species of Uredinales reported in this paper were collected by Mrs. Mary Strong Clemens in Morobe District, New Guinea. Of these 34 species 20 are described as new, with two serving as the basis for a new genus. The type specimens are deposited in the Arthur Herbarium, Purdue University Agricultural Experiment Station.

Puccinia mera sp. nov. (FIG. 10)

Urediis amphigenis, rotundatis vel ovoideis, 0.1–0.3 mm. longis, brunneis, sparsis; urediosporis late ellipsoideis vel obovoideis, 17–23 × 23–29 μ; membrana 1.5 μ cr., cinnamomeo-brunnea, moderate echinulata, poris germ. 2, aequatorialibus. Teliis urediis conformibus; teliosporis oblongo-ellipsoideis vel clavatis, ad apicem rotundatis, ad basim plerumque attenuatis, medio constrictis, 13–17 × 37–53 μ; membrana 1–1.5 μ cr., ad apicem 5–8 μ, aureo- vel castaneo-brunnea, levi; pedicello hyalino, sporam subaequante.

On *Schoenus* aff. *subaxillaris* Kukenth., Mt. Sarawaket, Apr. 14, 1939 (*10131bis*); Samanzing vicinity, Dec. 22, 1938 (*10398bis*); Upper Camp, Feb. 21, 1939 (*9879*); Mt. Sarawaket, June 8, 1939 (*s.n.*, type).

The apical thickening of the teliospores becomes paler terminally and has somewhat the appearance of a differentiated umbo.

Puccinia oblongatoides sp. nov. (FIG. 1)

Urediis amphigenis, maculis rufo-brunneis insidentibus, ellipticis vel oblongis, 0.2–0.5 mm. longis, sparsis, cinnamomeo-brunneis; urediosporis obovoideis vel oblongo-ellipsoideis, 12–17 × 23–29 μ; membrana 0.5–1.0 μ cr., hyalina, levi, poris germ. obscuris (nullis?). Teliis urediis conformibus sed

[1] Contribution from the Department of Botany, Purdue University Agricultural Experiment Station, Lafayette, Indiana.

[2] I am much indebted to the following persons for giving opinions concerning the identity of some of the hosts: Drs. S. F. Blake, H. D. House, I. M. Johnston, E. D. Merrill, H. N. Moldenke, G. L. Stebbins, Jr., and H. K. Svenson.

castaneo-brunneis; teliosporis oblongis vel clavatis, ad apicem rotundatis vel obtusis vel leniter attenuatis, ad basim attenuatis, medio constrictis, 13–17 × 38–50 μ; membrana 1–1.5 μ cr., ad apicem 5–8 μ, castaneo-brunnea; pedicellis fulvis, usque ad 30 μ longis.

On *Luzula* sp., Mt. Sarawaket, Apr. 22, 1939 (*s.n.*, type); Upper Camp, Feb. 21, 1939 (*s.n.*).

This species is closely related to *P. oblongata* (Lk.) Wint. but is readily distinguishable because of the smaller urediospores and teliospores.

Puccinia citricolor sp. nov. (FIG. 3)

Pycnia amphigena, subepidermalia, globosa, paraphysata, 100–135 μ diam. Aeciis amphigenis in maculis incrassatulis usque ad 15 mm. diam. profunde immersis, pallide flavidis, 0.2–0.3 mm. diam.; cellulis peridii laxe conjunctis, oblongo-ellipsoideis vel oblongis 25–40 × 45–75 μ, pariete interiore rugoso 3 μ cr., exteriore levi 2 μ cr.; aeciosporae late ellipsoideae vel oblongo-ellipsoideae, 28–40 × 39–55(–60) μ; membrana flavida verrucoso-rugosa 3–6 μ cr., ad apicem 8–18 μ. Uredia hypophylla, subepidermalia, flavida, sparsa vel laxe aggregata, 0.1–0.7 mm. diam.; urediosporae obovoideae, 24–30 × 33–50 μ; membrana flavida 2.5–4 μ cr., ad apicem 4–12 μ, valde aculeata, poris germ. obscuris. Telia hypophylla, subepidermalia, in maculis atro-brunneis usque ad 15 mm. diam. dense aggregata, flavida vel brunnea; teliosporae ellipsoideae, oblongo-ellipsoideae vel clavatae, utrinque rotundatae vel ad basim attenuatae, medio constrictae, 18–26 × 39–60 μ; membrana flavida 2 μ cr. vel ad apicem 2.5–3.5 μ; pedicellis concoloris 8–12 × 10–20 μ. Statim germ.

On *Smilax* sp., Sattelberg, Nov. 18, 1935 (*902*), Nov. 30, 1935 (*1038*, type); Yunzaing, Apr. 25, 1936 (*2958*), June 11, 1936 (*3276*), July 1, 1936 (*3484*), July 17, 1936 (*s.n.*), Aug. 12, 1936 (*3886bis*), Aug. 21, 1936 (*s.n.*).

Puccinia citricolor differs from the previously described species of *Puccinia* on *Smilax* because of the non-inflated, short and usually largely deciduous pedicels and the nearly uniform wall of the teliospores. All four spore stages are present in the type, pycnia, aecia and telia in no. *902* and telia in the remaining collections. The close association of the aecia and telia and the presence of teliospores in the uredia indicate that all belong to a single species.

Mrs. Clemens notes the rust as "yellow" and in dried specimens the young sori remain yellowish with an olivaceous tint which changes with age to sordid brown. The greenish tint in the teliospores is conspicuous microscopically.

PUCCINIA CONGESTA Berk. & Br.

On *Polygonum chinense* L., Yunzaing, Apr. 25, 1936 (*2949*), Aug. 20, 1936 (*3933A*); vicinity of Milulunga, July 6, 1939 (*10430*).

Puccinia aegroides sp. nov. (FIG. 4)

Pycniis ignotis. Aeciis plerumque hypophyllis, totam folii superficiem occupantibus, cupulatis; cellulis peridii 15–21 × 23–30 μ; membrana rugosa 3 μ cr.; aeciosporis globosis, 11–16 × 13–18 μ; membrana 0.5–1 μ cr., subtiliter verruculosa. Urediis amphigenis, rotundatis, 0.1–0.3 mm. diam., pallide cinnamomeis; urediosporis oblongo-ellipsoideis, ellipsoideis vel obovoideis, 14–21 × 23–34 μ; membrana 2 μ cr., flavida vel pallide cinnamomeo-brunnea, echinulata, poris germ. 2, aequatorialibus. Teliis urediis conformibus sed castaneis; teliosporis variabilis, oblongis, ellipsoideis vel late ellipsoideis, ad apicem rotundatis, ad basim attenuatis vel rotundatis, medio non vel leniter constrictis, 15–20 × 24–35 μ; membrana 1.5 μ cr., apice 3–5 μ et papillata, in cellulis apicalis subtiliter verrucosa; pedicello hyalino, brevi.

On *Viola* sp., Upper Camp A, Mar. 1939 (*10006*); Mt. Sarawaket, Apr. 14, 1939 (*s.n.*), Apr. 17, 1939 (*s.n.*, type), June 8, 1939 (*s.n.*).

This rust is closely related to *P. aegra* Grove but differs because of longer urediospores and apically verrucose teliospores. Both lack pycnia, both have systemic aecia and in both the pore in the lower cell of the teliospore is at the septum.

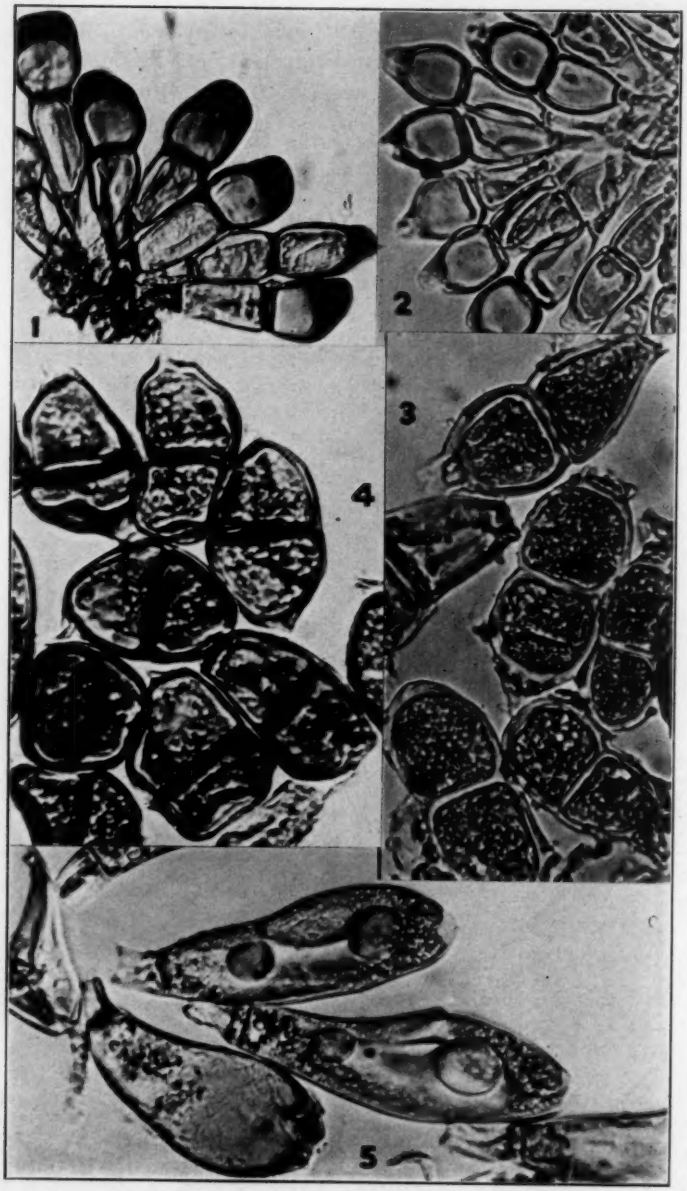
PUCCINIA HALORAGIDIS Sydow

On *Haloragis micrantha* R. Br., vicinity of Samanzing, Nov. 22–23, 1938 (*9361*), Dec. 22, 1938 (*s.n.*); Upper Camp, Feb. 19, 1939 (*9844*).

Teliospores present in no. *9844* are somewhat smaller than those in the Japanese specimens at my disposal but fall within the range given in the original description. The species is scarcely distinct morphologically from the North American *P. Proserpinacae* (Berk. & Curt.) Farl.

Puccinia morobeana sp. nov. (FIG. 2)

Urediis hypophyllis, subepidermicis, brunneis, rotundatis vel ovatis, 0.1–0.5 mm.; urediosporis globoideis vel late ellipsoideis, 16–20 × 19–24 μ; membrana cinnamomea 1.5 μ cr., poris germ. 2, aequatorialibus. Teliis conformibus; teliosporis clavatis vel oblongo-clavatis, ad apicem rotundatis vel leniter attenuatis, ad basim attenuatis, medio leniter constrictis, 11–16 × 31–42(–47) μ; membrana aureo-brunnea 1–1.5 μ cr., ad apicem 3–7 μ, levi; pedicello hyalino, sporam aequante vel breviore, fragili.



FIGS. 1–5.

On *Gentiana* aff. *Ettinghausenii* F. Muell., Mt. Sarawaket, May 1939 (*s.n.*), June 8, 1939 (*10235*, type). On *Gentiana* near *Mac Gregorii* Hemsl., Upper Camp A, Apr. 10, 1939 (*10117G*); Mt. Sarawaket, June 8, 1939 (*10235B*), June 15, 1939 (*10247*B).

Puccinia morobeana is similar to *P. Cockaynei* G. H. Cunn. but has narrower and lighter colored teliospores.

Puccinia Ixeridis sp. nov. (FIG. 12)

Pycniis hypophyllis, totam folii superficiem occupantibus, subepidermicis, globosis, 115–165 μ diam. Aeciis inter pycnia sparsis, cupulatis, 0.2–0.35 mm. diam., cellulis peridii rhomboideis vel ellipsoideis, 16–21 × 25–30 μ, pariete interiore rugoso 3–6 μ cr., exteriore verruculoso 1 μ cr.; aeciosporae late ellipsoideae vel oblongo-ellipsoideae, 13–18 × 19–26 μ; membrana hyalina verruculosa 1 μ cr. Urediis epiphyllis, flavidis, minutis, 0.1–0.2 mm. diam., sparsis; urediosporae obovoideae, late ellipsoideae vel globosae, 15–19 × 18–22 μ; membrana pallide flavida vel hyalina 1–1.5 μ cr., moderate echinulata, poris germ. aequatorialibus, 3. Teliis conformibus sed brunneis; teliosporae ellipsoideae vel late ellipsoideae, utrinque rotundatae, medio leniter constrictae, 24–30 × 34–40 μ; membrana 1–1.5 μ cr., pallide castaneo- vel aureo-brunnea, levi; poro superiore subapicali, inferiore infra medium loculum sito; pedicello hyalino, fragili, mox deciduo.

On *Ixeris papuana* (S. Moore) Stebbins, vicinity of Samanzing, Feb. 1939 (*ex 9871bis*, type), Upper Camp A, Mar. 1939 (*s.n.*); on *Ixeris umbellata* (Mattf.) Stebbins, Upper Camp, Feb. 17, 1938 (*9831*).

It is impossible with the available material to be certain that the aecia actually belong with the uredia and telia but their apparent association favors this view. The specimen taken as the type was segregated from no. *9871bis* which is also taken as the type of *P. ixeridicola*, but the latter is obviously a microcyclic species and has no connection with the aecia.

Puccinia ixeridicola sp. nov. (FIG. 13)

Pycnia, aecia et uredia nulla. Telia subepidermalia amphigena, brunnea, pulvinata, rotundata, dense aggregata in maculis 1–3 mm. diam.; teliosporae oblongae vel clavatae, ad apicem rotundatae vel attenuatae, ad basim attenuatae, medio non vel vix constrictae, 10–15 × (23–)29–40 μ; membrana hyalina vel pallide flavida, 1 μ cr., ad apicem 3–6 μ cr., levi; pedicello hyalino, sporam aequante vel breviore. Statim germ.

FIG. 1, teliospores of *Puccinia oblongatoides* on *Luzula* (× 650); 2, teliospores of *Puccinia morobeana* on *Gentiana* (× 700); 3, teliospores of *Puccinia citricolor* on *Smilax* (× 725); 4, teliospores of *Puccinia aegroides* on *Viola* (× 900); 5, teliospores of *Uromyces permeritus* on *Tournefortia* (× 750).

On *Ixeris papuana* (S. Moore) Stebbins, vicinity of Samanzing, Feb. 1939 (*9871bis*, type), Upper Camp A, Mar. 1939 (*s.n.*).

UROMYCES AFFINIS Wint.

On *Hypoxis* sp., Malalo Mission, May 27, 1936 (*3148*); Kajabit Mission, July 24, 1939 (*10475*).

Only uredia are present in these collections but they differ in no way from the uredia of American specimens of *U. affinis*.

Uromyces permeritus sp. nov. (FIG. 5)

Pycniis epiphyllis, subepidermalibus, 130–150 μ latis, 165–200 μ altis, maculis incrassatulis usque 3 mm. diam. occupantibus. Aeciis uredinoidibus, amphigenis, inter pycnia sparsis, cinnamomeo-brunneis, plus minusve profunde immersis, 150–300 μ diam.; aeciosporae obovoideae, 20–30 × 36–56 μ; membrana 2 μ cr., ad apicem 3–6 μ, cinnamomeo-brunnea, valde echinulata, poris germ. 3, aequatorialibus. Urediis hypophyllis, subepidermalibus, sparsis vel laxe aggregatis, cinnamomeo-brunneis, 0.1–0.2 mm. diam.; urediosporis aeciosporis conformibus. Teliis urediis conformibus; teliosporae oblongo-ellipsoideae, 20–26 × 42–66 μ; membrana flavida vel aureo-brunnea, levi, 1 μ cr., ad apicem 3–6 μ; pedicellis flavidis, usque 16 μ latis, sporam aequante vel longiore.

On *Tournefortia* probably *sarmentosa* Lam., above Boana, Aug. 23, 1938 (*8702*).

The apical thickening of the teliospores consists of a hyaline papilla which disappears during germination and, since the spores germinate immediately, is apt not to be seen. *U. dolichosporus* D. & H. is a similar species but has smaller spores.

UROMYCES WEDELIAE P. Henn.

On *Wedelia biflora* (L.) DC., Malalo Mission, Salamaua, Aug. 22, 1935 (*11*); Sattelberg, Jan. 25, 1936 (*1376*); Mosum to Lae, July 7, 1939 (*s.n.*).

UROMYCES BIDENTICOLA (P. Henn.) Arth.

On *Bidens* sp., Sattelberg, Sept. 20, 1935 (*162*), Oct. 1935 (*s.n.*); Yoangen Village, June 18, 1936 (*3380*); Wau, July 19, 1939 (*10456V*).

Corbulopsora gen. nov. (*Pucciniaceae*)

Pycnia subepidermalia, paraphysata. Aecia subepidermalia, cupulata, peridio praedita; aeciosporae catenulatae. Uredia telia conformibus; uredio-

sporae pedicellatae, echinulatae, poris germ. instructae. Telia subepidermalia, erumpentia, peridio valliforme cincta; teliosporae unicellulares solitarie in apice pedicelli natae, apice poro germinationis unico instructae.

TYPE SPECIES: *Corbulopsora Clemensiae* Cumm.

Corbulopsora Clemensiae sp. nov. (FIG. 6, 7, 9)

Pycnia epiphylla, profunde immersa, globosa, 180–250 μ diam. Aecia epiphylla, profunde immersa, in maculis brunneis laxe aggregata, cupulata, 0.4–0.6 mm. lata, 0.3–0.5 mm. alta; cellulis peridii oblongis vel rhomboideis, 20–45 × 55–90 μ, pariete interiore verrucoso 8–11 μ cr., exteriore striato 2 μ cr.; aeciosporae oblongo-ellipsoideae vel late ellipsoideae, 25–44 × 39–55 μ; membrana hyalina vel pallide flavida, 3.5–6 μ cr., valde verrucosa. Uredia hypophylla subepidermalia, cylindracea, 100–200 μ lata, 165–250 μ alta; peridio valliformi ex cellulis 13–30 × 130–165 μ composito; membrana flavo-brunnea 2–3 μ cr.; urediosporae late ellipsoideae vel obovoideae, 33–40 × 39–55 μ; membrana hyalina vel pallide flavida, 3.5–5 μ cr., valde echinulata, poris germ. 6–8, sparsis instructa. Telia uredia conformibus sed castanea; teliosporae cylindraceae vel oblongo-cylindraceae, ad apicem rotundatae vel obtusatae, ad basim leniter attenuatae, 23–32 × 80–112 μ; membrana aureo- vel castaneo-brunnea, 1.5 μ cr., ad apicem 9–13 μ, levi; pedicello hyalino, sporam aequante vel longiore. Statim germ.

On *Olearia* sp., vicinity of Samanzing, Dec. 30, 1939 (*10341*), Feb. 1939 (*9690V*, type).

Corbulospora gravida sp. nov. (FIG. 8)

Pycnia epiphylla subepidermica, profunde immersa, globosa, 190–275 μ diam. Aecia hypophylla, profunde immersa, plus minusve sparsa vel in maculis brunneis laxe aggregata, cupulata vel cylindracea, 0.3–0.5 mm. lata, 0.4–0.8 mm. alta; cellulis peridii oblongis vel rhomboideis, 25–40 × 50–75 μ; pariete interiore verrucoso 5–8 μ cr., exteriore striato 1.5 μ cr.; aeciosporae ellipsoideae vel oblongo-ellipsoideae, 25–39× 50–75 μ; membrana hyalina 2–2.5 μ cr., valde verrucosa. Uredia ignota. Telia hypophylla, subepidermica, pulvinata vel cylindracea, 100–165 μ lata, 175–250 μ alta; peridio valliformi ex cellulis 15–25 × 100–150 μ composito; membrana flavida 3–5 μ cr.; teliosporae ellipsoideae vel oblongo-ellipsoideae, ad apicem rotundatae, ad basim attenuatae, 30–42 × 70–105 μ; membrana aureo-brunnea 1.5–2 μ cr., ad apicem 8–12 μ cr., levi; pedicello hyalino, sporam aequante. Statim germ.

On *Olearia* sp., vicinity of Samanzing, Jan. 7, 1939 (*10369*); Mt. Sarawaket, Apr. 1939 (*10117N*), May 1939 (*s.n.*, type).

The rusts described here as *Corbulopsora Clemensiae* and *C. gravida* are considered to have morphological features sufficiently distinctive to require segregation in a new genus. Both species have large teliospores with the characteristics of those of the genus

FIGS. 6-9.

Uromyces but the spores are produced within an encircling peridium composed of long, slender, palisade-like cells united laterally.

The peridial cells and aeciospores of both species are large and more reminiscent of those found in such genera as *Coleosporium* and *Chrysomyxa* than of those usual in *Uromyces*. Their walls are coarsely sculptured with rather large tubercles which have an irregular and more or less stellate outline. In *C. gravida* the tubercles are somewhat deciduous, slightly smaller and borne on a thinner wall than in *C. Clemensiae*.

Uredia are known only for *C. Clemensiae* and are produced within the same stockade-like peridium as are the teliospores, or the teliospores may develop in the uredia. The teliospores are of approximately the same length in both species but those of *C. Clemensiae* are significantly narrower. Both germinate at once.

Sphaerophragmium boanense sp. nov. (FIG. 14)

Teliis maculis brunneis usque ad 5 cm. diam. insidentibus, hypophyllis, subepidermicis, dense aggregatis, brunneis, 150–250 μ diam., primo epidermide tectis, dein poro rotundo apertis; teliosporis globosis, ellipsoideis vel oblongis, cinnamomeis, ex cellulis 3–7 compositis, superficie tuberculis brunneis hemisphaericis, conicis vel truncatis obsitis, 25–39 × 39–49 μ; episporio 1.5 μ crasso, poris germ. obscuris; pedicello sporam circiter aequante vel plerumque breviore, dilute colorato.

On Anonaceae, Boana, July 6, 1938 (*8413*).

Of the three infected leaves in this collection one has a spot 3 cm. in diameter, in the second the apical one-third (about 5 cm.) of the leaf is involved, while the entire third leaf is uniformly occupied by sori. The third leaf may indicate a locally systemic mycelium.

Sphaerophragmium boanense is related to *S. Chevalieri* Har. and Pat. but differs in causing larger infected areas in which the sori are hypophyllous rather than epiphyllous. The telia are smaller and the sculpture on the teliospores is more regularly tuberculate.

FIG. 6, teliospores of *Corbulopsora Clemensiae* on *Olearia* (× 550); 7, telia of *Corbulopsora Clemensiae* with a few urediospores; note the surrounding palisade-like peridia (× 125); 8, teliospores of *Corbulopsora gravida* on *Olearia* (× 550); 9, a portion of the telial peridium of *Corbulopsora Clemensiae* separated out to show the long laterally united peridial cells (× 425).

HAMASPORA ACUTISSIMA Sydow

On *Rubus diclinia* F. Muell., vicinity of Samanzing, Dec. 30, 1938 (*10343*). On *Rubus moluccanus* L., Sattelberg, Sept. 20 1935 (*116*). On *Rubus* sp., between Sattelberg and Quembung, Dec. 13, 1935 (*1121*), Dec. 18, 1935 (*s.n.*); Samanzing, June 28, 1939 (*10381*).

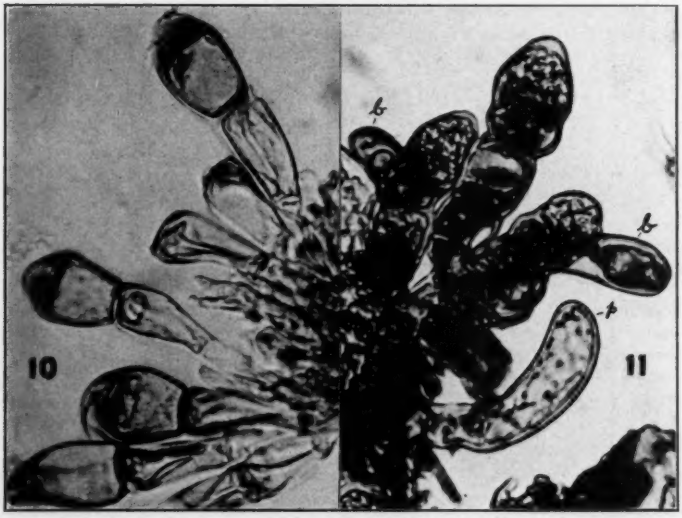


FIG. 10, teliospore of *Puccinia mera* on *Schoenus* (× 750); 11, portion of a crushed and stained telium of *Kuehneola papuana* on *Rubus* showing three teliospores, two with one basidial initial (*b*) each, and one paraphysis (*p*) (× 900).

Uredia could be found on only one collection but the long cylindrical telial paraphyses as well as the size and septation of the teliospores indicate *H. acutissima.* Since the uredia of *Hamaspora* often furnish more distinctive characters than do the uredia, as in *H. acutissima* and *H. benguetensis* Sydow, it may be that more than a single species is involved. The uredia mentioned above agree fairly well with those of *H. acutissima* but they are without accompanying telia.

Kuehneola papuana sp. nov. (FIG. 11)

Pycnia et aecia ignota. Uredia subepidermalia, hypophylla, flavida, pulverulenta, 0.1–0.3 mm. diam.; paraphysibus ad marginem sori evolutis, ad basim coalitis, cylindraceis, curvatis, 8–10 × 35–50 μ; membrana hyalina, 1 μ cr.; urediosporae obovatae, 13–16 × 17–25 μ; membrana hyalina vel pallide flavida, 1–1.5 μ cr., dense minuteque echinulata, poris germ. 4–6, sparsis. Telia uredia conformibus sed compacta; teliosporae clavatae vel cylindrico-clavatae, 1–5 septatae, ad septa non vel leniter constrictae, apice rotundatae vel leniter attenuatae, 13–16 × 42–50 μ; membrana hyalina 1–1.5 μ cr., ad apicem usque 3 μ, levi; pedicello brevissimo. Statim germ.

On *Rubus papuanus* Schltr. vel aff., Mt. Sarawaket, May 1939 (*10216*).

Adequate numbers of uredia are present in this collection but telia are rare and only one good mount was obtained. Certain features of the teliospores are not in accord with the characters of the genus *Kuehneola*. The cells of the teliospores are firmly united and give no impression of being catenulately produced, although the early stages of septation were not observed. Moreover, there is no indication of the presence of germ pores. Germination occurs at varying locations in the cells by the production of an outgrowth of the wall. The wall of the structure thus produced is of the same thickness as that of the teliospore and is continuous with it. The protoplasm moves into this outgrowth, which has a diameter nearly equal to that of the teliospore cell, and is then walled off by the formation of a septum about 6 μ distant from the teliospore. By this septation a terminal cell with an approximate size of 10 × 14 μ is formed, with the original thickness of the wall retained. This terminal cell is presumably the basidium (FIG. 11, *b*) but, despite careful study, its further development could not be determined. It may be assumed, however, that the basidial initial by continued differentiation produces septae, sterigmata and basidiospores.

Paraphyses (FIG. 11, *p*), reminiscent of those found in some species of *Phragmidium* and of *Hamaspora*, are present around both the uredia and the telia. *Kuehneola*, as delimited by Dietel (E. & P. Nat. Pfl. **6**: 60. 1928), does not form paraphyses and is restricted to rosaceous hosts. He places similar but paraphysate species which parasitize hosts belonging in families other than the Rosaceae in *Cerotelium*. The status of these two genera is con-

fused and the discovery of the rosaceous but paraphysate *K. papuana* further complicates the situation.

The presence or absence of paraphyses is not generally considered to be especially significant in the characterization of genera of the Uredinales. Certainly such usage cannot be consistently adopted. Structurally, the teliospores of *K. papuana* differ somewhat, however, from those of other species of *Kuehneola*. The thick-walled basidial initial is unusual. Certainly the species is not a *Cerotelium*. Perhaps it is generically distinct and deserving of a position intermediate between *Kuehneola* and *Hamaspora* but without adequate telial material it seems inadvisable to introduce a new genus.

CEROTELIUM FICI (Cast.) Arth.

On *Ficus* sp., Sattelberg, Dec. 6, 1935 (*1204*), Dec. 17, 1936 (*1226*); Heldsbach, Jan. 31, 1936 (*1740*); Malalo Mission, Salamaua, May 25, 1936 (*3159*); Yunzaing, July 17, 1936 (*3605A*); Samanzing to Milulunga, July 5, 1939 (*10431*).

BUBAKIA EHRETIAE (Hirats.) S. Ito

On *Ehretia* sp., Sattelberg, Oct. 23, 1935 (*575*), Nov. 18, 1935 (*920*); Quembung trail, Dec. 9, 1935 (*1175*); Wareo, Dec. 25, 1935 (*1361*); Heldsbach to Sattelberg, Jan. 31, 1936 (*1751*); Butaweng saw mill, Mar. 18, 1936 (*2101*); Sattelberg, Wareo trail, Feb. 18, 1938 (*s. n.*).

Small (45–65 μ diam.) hemispherical or conical, subcuticular pycnia accompanied by uredinoid aecia, with spores like the urediospores, are present in no. 1175 in close association with uredia and telia. There is no reason to doubt that the primary and secondary stages belong to a single species. In addition to localized infection of the leaves the rust also is capable of infecting and causing hypertrophy of the fruits (no. *920*). Sections of the fruits prove the uredia to be almost as frequent internally as externally.

PHAKOPSORA TECTA Jackson & Holway

On *Commelina* sp., Sattelberg, Oct. 19, 1935 (*506*); vicinity of Milulunga, July 5, 1939 (*10430bis*).

Crossopsora Clemensiae sp. nov.

Pycnia subcuticularia, maculis leniter incrassatulis 1–3 mm. diam. occupantibus, hypophylla, hemisphaerica, 85–115 μ diam. Aecia hypophylla, inter pycnia sparsa, profunde immersa, peridio destituta, 130–215 μ diam.; aeciosporae ellipsoideae, 16–20 × 22–25 μ; membrana hyalina, 1.5 μ cr. vel ad apicem leniter incrassata, moderate echinulata. Uredia ignota. Telia hypophylla, subepidermalia, laxe aggregata, brunnea, 100–250 μ diam., 80–120 μ alta; teliosporae oblongae, 13–16 × 18–22 μ; membrana hyalina, 1 μ cr.

On *Glochidion* sp., Boana, Aug. 13, 1938 (*8622bis*).

Crossopsora Clemensiae is readily distinguishable from *C. Sawadae* (Sydow) Arth. & Cumm. because the telia are not horn-like

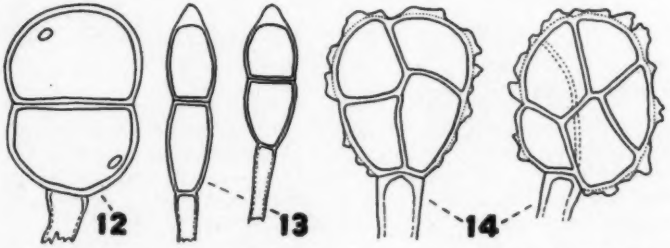


FIG. 12, one teliospore of *Puccinia Ixeridis* on *Ixeris*; 13, two teliospores of *Puccinia ixeridicola* on *Ixeris*; 14, two teliospores of *Sphaerophragmium boanense* on Anonaceae (× 650).

but only erumpent-pulvinate and originate beneath the epidermis rather than deep within the mesophyll. Although the telia are not filiform *Crossopsora* seems the logical genus in which to place this species. The aecia, although old, are obviously like those of *C. Sawadae* and, without accompanying telia, could not well be distinguished. In this collection they are so closely associated with the telia, however, that they certainly are genetically related.

CROSSOPSORA SAWADAE (Sydow) Arth. & Cumm.

On *Glochidion* sp., Boana, June 4, 1938 (*8325*); Abe, Sarawaket, June 15–18, 1938 (*8326*); above Boana, Aug. 26, 1938 (*s. n.*); Kajabet Mission, July 27, 1939 (*10482a*).

There are three rusts known on *Glochidion* in New Guinea. For a discussion of the differences see *Crossopsora Clemensiae* and *Aecidium foederatum*.

Crossopsora Malloti (Racib.) comb. nov. (*Cronartium Malloti* Racib., Parasit. Algen Pilze Javas I, p. 23, 1900; *Uromyces Malloti* P. Henn., Engl. Bot. Jahrb. **15**: 4. 1892; *Uredo Malloti* P. Henn., Vestergr. Micr. Rar. Sel. *870.* 1905).

On *Mallotus* sp., Boana, May 6, 1938 (*8192*); Kajabit Mission, Aug. 15, 1939 (*10577*).

Because the uredia have septate peripheral paraphyses rather than a peridium this species is best referred to the genus *Crossopsora.*

UREDO ARTOCARPI Berk. & Br.

On *Artocarpus* sp., Sattelberg, Dec. 6, 1935 (*1117A*), Dec. 24, 1935 (*s. n.*); Quembung Mission, Mar. 19 and 23, 1936 (*2140*).

Uredo falcifera sp. nov.

Urediis subepidermalibus, hypophyllis, sparsis, brunneis, pulverulentis; paraphysibus peripheric is copiosis, inferne conjunctis, plerumque falciformis, castaneo-brunneis, 6–12 × 25–55 μ; membrana 2 μ cr.; urediosporae plerumque obovoideae, 14–18 × (19–)23–30 μ; membrana aureo- vel cinnamomeo-brunnea 1 μ cr., moderate echinulata, poris germ. obscuris.

On *Rubus Macgregorii* F. Muell., Mt. Sarawaket, June 6, 1939 (*10222*).

Telia could not be found among the relatively abundant uredia but the species will probably be found to belong in *Hamaspora.* The uredia, judging by the description, of *H. Rubi-Sieboldii* (Kawagoe) Dietel are much like those of *U. falcifera* but with less typically sickle-shaped paraphyses. In gross appearance, intensity of the pigmentation and in the general shape of the paraphyses the sori of *U. falcifera* are like the uredia of *H. benguetensis* Sydow but the spores of the latter are shorter and thus more rotund.

Uredo morobensis sp. nov.

Uredia subepidermalia amphigena, pulverulenta, rotundata vel ovoidea, 0.1–0.4 mm. diam. cinnamomea; urediosporae late ellipsoideae vel globoideae, 16–20 × 20–23(–26) μ; membrana cinnamomeo-brunnea 1–1.5 μ cr., moderate echinulata, poris germ. 2, aequatorialibus.

On *Cerastium* probably *papuanum* Schltr., Mt. Sarawaket, Mar. 15, 1939 (*10023*, type), Apr. 14, 1939 (*10135*), Apr. 18, 1939 (*10153*).

UREDO CALLICARPAE Petch.

On *Callicarpa pedunculata* R. Br., Wareo, Dec. 26, 1935 (*1368*), Jan. 2, 1936 (*1452, 1453*); Yunzaing, June 12, 1936 (*3264A*), July 16, 1936 (*s. n.*).

Epiphyllous, subcuticular, conical pycnia 100–135 μ in diameter are present in no. 1452, encircled by amphigenous, subepidermal, paraphysate uredinoid aecia. The aecia are like the uredia except that the septate paraphyses are somewhat smaller. The aeciospores agree in size, color and echinulation with the urediospores and the two stages undoubtedly belong together.

UREDO CUMULA Arth.

On *Buchnera* probably *urticifolia* R. Br., Salamaua, May 25, 1936 (*3141*).

It is remarkable that this species, previously known only from the type specimen collected in Cuba, should be found in New Guinea but the pulverulent uredia are the same bright cinnamon-brown and the urediospores are indistinguishable. The specimen is only scantily infected.

Uredo adapertilis sp. nov.

Uredia hypophylla, subepidermalia, laxe gregaria, rotundata, brunnea, 130–200 μ diam.; urediosporae obovoideae, ellipsoideae vel oblongo-ellipsoideae, 18–24 × 29–39 μ; membrana flavida, moderate echinulata, 1–1.5 μ cr., poris germ. obscuris, 5–7 aequatorialibus instructa.

On *Erechtites haplogynus* (F. Muell.) Mattf. vel aff., Marsh Meadow Camp, Dec. 22, 1938 (*s. n.*, type); vicinity of Samanzing, Jan. 1939 (*s. n.*).

The sori are lenticular in section and open by an irregular and rather small aperture. The germ pores seem to be large but nevertheless are too obscure to count with accuracy.

UREDO MICROGLOSSAE Petch.

On *Microglossa volubilis* (Wall.) DC., Wareo, road to Heldsbach, Jan. 10, 1936 (*1610*); Yunzaing, June 1, 1936 (*3277A*); Yoangen, June 18, 1936 (*s. n.*).

Uredo mimica sp. nov.

Uredia hypophylla, subepidermalia, sparsa vel laxe aggregata, bullata, flavida, 0.1–0.2 mm. diam.; urediosporae ellipsoideae vel late ellipsoideae, 13–16 × 17–20 μ; membrana 1–1.5 μ cr. hyalina vel pallide flavida, echinulata, poris germ. obscuris.

On *Microglossa volubilis* (Wall.) DC., Wareo, Dec. 26, 1936 (*1373a*, type); Yunzaing, June 11, 1936 (ex *3277A*).

Uredo mimica is close to *Uredo Microglossae* Petch but has decidedly smaller and more nearly globoid spores. The two species were both present in the last number cited.

Aecidium foederatum sp. nov.

Pycnia amphigena, subcuticularia, 115–170 μ diam., hemisphaerica vel conica, maculis flavidis incrassatulis usque 5 mm. diam. occupantibus. Aecia epiphylla inter pycnia sparsa, peridio destituta, profunde immersa, 160–250 μ diam.; aeciosporae irregulariter obovatae, ellipsoideae vel oblongae, utrinque rotundatae, obtusae vel attenuatae, 17–29 × 29–45 μ; membrana hyalina vel pallide flavida, irregulariter 1.5–3.5 μ cr., ad apicem et basim 3–10 μ, remoteque verrucoso-echinulata.

On *Glochidion* sp., vicinity of Samanzing, Dec. 9, 11, 1938 (*10344*), Dec. 11, 1938 (*s. n.*), Jan. 7, 1939 (*s. n.*, type).

Aecidium foederatum has the same structure as *A. innatum* Sydow & Butl. and the aecia of *Crossopsora Sawadae* (Sydow) Arth. & Cumm. and *C. Clemensiae* Cumm. but is readily distinguishable because of its larger irregular spores with the wall much thickened apically and basally. The sculpture of the walls is of the same nature as in *C. Sawadae* and *C. Clemensiae* but more remote or perhaps absent in some spores. *Aecidium innatum* is described as having densely verrucose aeciospores. A peridium is lacking in all but the sorus is aecidioid in shape.

AECIDIUM KAERNBACHII P. Henn.

On *Ipomoea Pes-caprae* (L.) Roth, Lae, July 15, 1939 (*10449*). On *Ipomoea* sp., Malalo Mission, Salamaua, Aug. 20, 1935 (*6*); Lae, July 15, 1939 (*10450bis*). On *Merremia* sp., Malalo Mission, Salamaua, Aug. 22, 1935 (*10*); Sattelberg, Sept. 28, 1935 (*272*), Feb. 15, 1936 (*1844*); Lae, July 15, 1939 (*s. n.*).

Following studies conducted in the Philippine Islands Stevens and Mendiola (Phil. Agric. **20**: 7. 1931) transferred this species

to the genus *Endophyllum*. Since they also found that spores from apparently the same rust on *Lepistemon obscurum* produced "long indeterminate infection tubes" and since their illustrations are not too convincing it seems best to list this species under *Aecidium*.

Aecidium advectitium sp. nov.

Pycnia hypophylla, subepidermica, globosa, 85–120 μ diam. Aecia hypophylla, plus minusve aequaliter denseque distributa, totam folii superficiem occupantibus, cupulata, brevi, 0.2–0.4 mm. diam.; cellulis peridii globosis vel rhomboideis, 18–26 × 23–30 μ; pariete interiore 3 μ cr. rugoso, exteriore 4–5 μ cr. striato; aeciosporae globosae vel late ellipsoideae, 20–26 × 24–30 μ; episporio 1–1.5 μ cr. hyalino, verruculoso.

On *Plantago* sp., Mt. Sarawaket, June 15, 1939 (*s. n.*); Upper Camp A, Mar. 11, 1939 (*10009*, type).

This species differs from *A. Plantaginis-variae* McAlpine because of its systemic habit, but seems to be similar otherwise.

AECIDIUM MICROSTOMUM Berk.

On *Pratia angulata* Hook. f., vicinity of Samanzing, Nov. 22–23, 1938 (*9359*), Dec. 9 and 22, 1938 (*s. n.*); Marsh Meadow Camp, Feb. 10, 1939 (*s. n.*).

All of the specimens are rather fragmentary but the rust is probably this species, which has systemic aecia without peridia or with only scattered perial cells present. Pycnia were not found, although they have been described for the species.

Aecidium Hecatactidis sp. nov.

Pycniis non visis. Aeciis amphigenis, cupulatis vel breviter cylindraceis, 200–250 μ diam., totam folii superficiem occupantibus; cellulis peridii firme conjunctis, rhomboideis, ellipsoideis vel oblongis, 15–18 × 23–35 μ, pariete interiore 2.5–3 μ cr. rugoso, exteriore 3–4 μ cr. striato; aeciosporae globoideae vel late ellipsoideae, 12–16 × 15–19 μ; membrana 1 μ cr., hyalina, minuteque verruculosa.

On *Hecatactis* sp., Upper Camp, Feb. 15, 1939 (*9841bis*, type); Mt. Sarawaket, June 8, 1939 (*s. n.*).

THE ARTHUR HERBARIUM,
PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

NOTES ON THE MYCETOZOA—IV

ROBERT HAGELSTEIN

The fruiting bodies of the Mycetozoa did not appear abundantly during the summer of 1939 in the territory that we usually cover. The lack of early spring rains, so necessary to the revival of the sclerotium, and the long drought which did not end until the middle of August, made collecting almost useless until then.

Mr. Rispaud and I attended the Foray of the Mycological Society of America held in the Great Smoky Mountains National Park, August 17–20. We arrived two days earlier and found that it had been dry for several weeks, so that no developments were seen except old ones which appeared after the preceding rains. During and following fresh rains, the conditions became better, and we stayed long enough to take advantage of them. Our best location was the series of small ravines crossing the road a few miles south of Newfound Gap, at an altitude of about 4000 feet, although good forms were found elsewhere. *Didymium crustaceum* Fries was coming out at almost every stopping place and was probably the most abundant species fruiting at the time. It matures well under ordinary travelling facilities provided the outer shell has formed. *Physarum Listeri* Macbr. and *Trichia erecta* Rex were not rare in the pine and hemlock belts at 4000 feet, and four or five collections of each were made. These species were also abundant in the Laurentian Mountains of upper Quebec after last year's Foray. Two groves of bearing chestnut, old trees that survived the blight, were located in North Carolina and Virginia at 3000 feet or more. The fallen burs from the preceding year had numerous colonies of *Arcyria globosa* Schw. A development of *Comatricha subcaespitosa* Peck was eight feet across, but this species often forms large colonies. *Physarum sulphureum* Alb. & Schw., and its variety *sessile,* were taken several times, and their occurrence in association confirmed the opinions expressed in my Notes of last year describing their abundance in Quebec. In addition to the species more critically discussed in the later notes of this paper,

there were also found *Cribraria elegans* Berk. & Curt., *Diachea bulbillosa* (Berk. & Br.) List., *Physarum citrinellum* Peck, *Trichia subfusca* Rex, and many of the more common ones. The region, with its divers typographical features, timber belts of many kinds, and heavy annual rainfall, is ideal territory for the Mycetozoa, perhaps the best in the eastern United States.

Dr. Roy F. Cain spent some time collecting in Algonquin Park, Ontario, during the summer, and found among many others the rarely collected species *Badhamia decipiens* (Curt.) Berk., *Cribraria purpurea* Schrad., and *Diachea subsessilis* Peck. These forms may be common enough in other areas, but have seldom been seen in our journeys.

Wood with specimens that has been thoroughly dried in preparation for the herbarium becomes so hard at times that it is difficult to cut and trim with an ordinary knife. The best tool for this purpose is the old style razor still used in barber shops. Ask your barber to save for you the discarded ones that are useless for shaving. They should be taken out of the handles by driving out the pins that hold them, and mounted in an ordinary tool handle with supporting wedges to keep them tight. They need no further sharpening, and when nicked too much by frequent use are thrown away.

The ordinary forceps used for picking off sporangia intended for observation by the microscope are usually too coarse for manipulating the smaller ones. They can be ground to finer points on a stone, but this requires experience or the points may not match. A better way is to buy from a dealer in watchmaker's supplies the forceps used in picking up minute screws and other small parts of watches. These are ground to fine, matched points and are worth the investment.

In the following notes the year 1939 is meant when no other year is given, and the collections were made by Mr. J. H. Rispaud and me, in company, unless otherwise indicated.

BADHAMIA OVISPORA Racib. Reported again by E. Davis and W. D. Sutton as found at Byron, Ontario, in May. N. Y. B. G. Nos. *8980, 9173.*

CALONEMA AUREUM Morg. Two fine examples of the form were found during our trip to the Great Smoky Mountains in

August, one in North Carolina, and the other in Virginia. In both the faint spirals on the threads of the netted capillitium wind like a left-handed screw as in *Oligonema nitens* (Lib.) Rost. or in *Trichia*. The spores are reticulated like the spores of *Oligonema flavidum* Peck. The same features are in other specimens of the species here.

Developments of the common *Oligonema* should never be passed in the field but taken and the capillitium examined in order to find the rare *C. aureum*. In *Oligonema* this consists of free elaters. In *Calonema* it is a network. They are practically indistinguishable in the field, even with a hand lens. Our specimens were found by making a special drive, knowing the species occurred in the region, and taking every insignificant *Oligonema* back with us. The netted capillitium was not noticed until after our arrival home. N. Y. B. G. Nos. *2963, 2964*.

COMATRICHA RISPAUDII Hagelstein. The species was found again by Mr. Lloyd G. Carr in Augusta County, Virginia, in July. Besides the type locality on Long Island, New York, it has heretofore been collected at Ithaca, New York, and Hanover, New Hampshire. N. Y. B. G. No. *9266*.

COMATRICHA SUKSDORFII Ellis & Ev. Collected by J. H. Faull on leaves of the balsam-fir at Lake Timagami, Ontario, in June 1937, and communicated by Roy F. Cain. The sporangia are small and globose, much like those collected by Sturgis in Colorado (Colo. Coll. Pub. Sc. Ser. **12**: 33. 1907). The spores are 9–13 μ diam., purplish-gray, but more strongly spinulose than those in specimens from Oregon and Washington. N. Y. B. G. No. *8330*.

CRIBRARIA LAXA Hagelstein. The species has been found heretofore only in a limited area of a few hundred square feet at Albertson, Long Island, New York. It is gratifying, therefore, to note its collection in Augusta County, Virginia, by Mr. Lloyd G. Carr in July. The development is typical in every respect, even to the habitat on ground leaves and sticks. N. Y. B. G. No. *9262*.

CRIBRARIA SPLENDENS (Schrad.) Pers. The species is not common although we have found it before in Maine and in Central New York. A small but perfect colony was collected on the

summit of Klingmans Dome, Sevier County, Tennessee, at an altitude of 6600 feet, in August. The form resembles superficially the common *Cribraria intricata* Schrad. var. *dictydioides,* and small colonies which appear like the latter should not be ignored too hastily. N. Y. B. G. Nos. *3087, 3595, 4995.*

DIACHEA CYLINDRICA Bilgr. The species, so far as I know, has only been reported from Pennsylvania and New Hampshire. It was found again by Dr. H. C. Beardslee at Longwood, Florida, in December 1938. The form was regarded as a *Comatricha* by Macbride, but in the latter genus the stalk and columella are solid like in *Stemonitis.* In *Diachea* they are tubular, usually filled with lime granules, occasionally with lime crystals, or rarely without lime. In *D. cylindrica* the columella is tubular although lime-less. In this species—admittedly perplexing—it seems to me that the tubular columella is the important generic character. N. Y. B. G. No. *8955.*

DIANEMA HARVEYI Rex. This rare species which has not been reported from North America in many years, and then only twice, was found again by Eli Davis at Komoka, Ontario, in October. The all important character is the capillitium which consists of plain, simple threads divided into a few strands at the tops, and running from the base to the upper part of the sporangium-wall. The threads are not ornamented with spirals like in *Prototrichia metallica* (Berk.) Massee which the form resembles in general appearance. N. Y. B. G. No. *9178.*

DIDERMA MONTANUM Meylan. A collection of var. *album* (Torrend) List., on leaves, was made by Eli Davis at Komoka, Ontario, in October 1938. The sporangia are subglobose, not umbilicate, on stout stalks, with a prominent columella which may be a rounded extension of the stalk or somewhat spherical. All are white throughout due to the density of the globose, white, lime granules. The capillitium has colorless, slender threads, and slightly flexuose; the spores are pale purplish-brown, minutely spinulose, and measure 8–10 μ diam. The spores are not like those of *Diderma radiatum* (L.) Morg. which are dark and usually larger.

Superficially, this form resembles smooth phases of *Didymium squamulosum* (Alb. & Schw.) Fries, and students are cautioned

to examine carefully all gatherings of the latter species, as the two may be confused if the generic character is overlooked.

During the same month, at the same locality, Mr. Davis also made a small collection of what may be the typical *D. montanum*. The sporangia have the separable inner wall which is lacking in the other collection, but other features are not there, and they bear the same perplexing relationship to *D. radiatum* var. *umbilicatum* which I noted in discussing similar forms from Long Island, New York (Mycologia **28**: 584–585. 1936). Further collections of the species and variety are needed in order to obtain a better understanding of their relations to *D. radiatum*. N. Y. B. G. Nos. *9179, 9180.*

DIDERMA RUGOSUM (Rex) Macbr. A few typical sporangia on a leaf were found near Gatlinburg, Tennessee, in August, during the Foray of the Mycological Society of America. The form may be mistaken in the field for a poorly developed *Didymium nigripes* (Link) Fries. The fruiting period for the locality is probably about the first of August. N. Y. B. G. No. *4998*.

DIDYMIUM COMPLANATUM (Batsch) Rost. The form resembles plasmodiocarpous phases of *Didymium squamulosum* (Alb. & Schw.) Fries, so that similar specimens should not be rejected until carefully examined with the microscope.

It was found by Dr. Erdman West at Gainesville, Florida, in July 1935. The capillitium has the numerous, large vescicles, warted like the spores, which are characteristic of the species. Otherwise there is nothing to distinguish it from similar plasmodiocarps of *D. squamulosum* which we have collected. N. Y. B. G. No. *6872*.

DIDYMIUM OCHROIDEUM G. List. Found by Eli Davis at Byron, Ontario, in May. The color is somewhat paler than usual, and the spores are a little larger, 8.5–9.5 μ diam., in these respects similar to a specimen from Long Island, New York, where the species has been found on several occasions and varying slightly in characters. N. Y. B. G. No. *8989*.

FULIGO MEGASPORA Sturg. A specimen in the Herbarium of the New York Botanical Garden collected by the Rev. J. M. Bates at Long Pine, Nebraska, in July 1896, and labelled *Spumaria alba* is the present species. The lime is in large spherical granules.

The spores are 20 μ, or more, diam., very dark, and warted. Two collections from Dr. Erdman West made near Gainesville, Florida, in August 1933 and October 1935 are also the same species and are similar except that the spores are smaller, 12–15 μ diam. N. Y. B. G. Nos. *5185, 5770, 7136.*

HEMITRICHIA INTORTA List. This rare species was found by Eli Davis at Komoka, Ontario, in April. The specimen is finely developed and practically the same as the one from Massachusetts described in Mycologia **30**: 347–348, 1938. N. Y. B. G. No. *9181.*

LACHNOBOLUS CONGESTUS (Somm.) List. Not common in North America. It forms small clusters of heaped sporangia 3 to 8 mm. across and inconspicuous, so that it may be mistaken in the field for *Oligonema nitens* (Lib.) Rost. which it resembles. The capillitium and spores are diagnostic. Collected by W. D. Sutton at Komoka, Ontario, in December 1938. N. Y. B. G. No. *8978.*

LICEA BIFORIS Morg. The size of the sporangia is usually given as not exceeding 0.2 mm. In a specimen received from the Great Khingan Mountains of upper Manchuria there are many that measure 0.4 mm. with some that are 0.5 mm. Collected August 1931. Some authors still adhere to the position that differences in size warrant the proposal of new species. I cannot agree with them. There must be other and more important characters. N. Y. B. G. No. *8647.*

LICEA MINIMA Fries. An unusual phase of this species was found by Travis E. Brooks in Geary County, Kansas, in March 1938. The sporangia are extremely small, 0.1 mm. diam. or less, of a chestnut-brown color, and angular with the usual lines of dehiscence. They resemble *Licea castanea* G. List., but the spores are lilac in color and measure 10–12 μ diam. The usual phase of the species, which is common on dead coniferous wood, has much larger sporangia, almost black in color, and the spores are olivaceous-brown. N. Y. B. G. No. *9193.*

LYCOGALA EPIDENDRUM (L.) Fries. Heretofore I have always regarded small, dark phases of this species as *Lycogala exiguum* Morg. Occasionally we have found large forms that are very dark, or small ones that are very pale, and these could not be placed satisfactorily. I have made a careful study of all specimens

of *L. epidendrum* in the Herbarium of the New York Botanical Garden, and have come to the conclusion that *L. exiguum* must be regarded as a variety of *L. epidendrum* as Lister accepted it, and not as a valid species. The fact is, when I remove from what was formerly regarded as *L. exiguum* the forms that are clearly var. *tessellatum*—the second variety recognized by Lister—there is nothing left to distinguish the others except size, as the color may be dark or pale, and in all other respects they are the same as the typical form. Mere size or color are not sufficient to maintain a species, particularly here, as *L. epidendrum* in the typical phase varies in the size of the aethalia from very small to very large in the same colony, and also varies considerably in color in different developments. There is no important character to separate the various forms except the superficial vesicles in the cortex later described.

There are 33 specimens here which come within the range of the two varieties mentioned. Of these, 18 are var. *tessellatum* and very dark in color, due mainly to the multitude of vesicles in the walls of the aethalia. In all but two, the aethalia range in size from 1.2 mm. to 5 mm. The odd two are 7 mm. to 8 mm., well within the range of typical *L. epidendrum*. When the aethalia are examined with sufficient magnification as opaque objects, the vesicles are seen as irregular protuberances or warts, or thinly spread over small areas and so close together that they appear continuous. In most of the specimens the vesicles are densely pitted with minute depressions, but in two or three they are not so conspicuous. I have not observed this pitting in aethalia of typical *L. epidendrum* or in var. *exiguum*. If now a portion of the wall of an aethalium is observed through the microscope with transmitted light, it will be seen that the red vesicles are divided by partitions into many conspicuous, polygonal chambers, giving a cell-like or honeycomb appearance. These are usually in one layer but occasionally in more. The chambers are not found in the vesicles of typical *L. epidendrum* or var. *exiguum*. This is a character that distinctly sets out var. *tessellatum*.

The remaining 15 specimens are regarded here as var. *exiguum*. The aethalia range in size from 1.2 mm. to 3 mm., and in the majority are dark as in var. *tessellatum* with some reddish or pale

ochraceous. The color is influenced somewhat by the number of vesicles and their thickness. These cannot be regarded as more than a variety.

Morgan in describing *L. exiguum* (Jour. Cin. Soc. Nat. Hist. **15**: 134. 1893) did not mention chambered vesicles, and the description fits superficially forms of both varieties as here recognized. It is possible that he had both among his herbarium material, but even so, this cannot invalidate the later name proposed by Lister as var. *tessellatum* (in Penz. Myx. Buit. 77. 1898) for the form with chambered vesicles.

Specimens of var. *tessellatum* in the New York Botanical Garden Herbarium are from New York, Pennsylvania, Virginia, and Florida. Var. *exiguum* is there from New York, Pennsylvania, West Virginia, North Carolina, Tennessee, Quebec, Austria, Roumania, and Switzerland.

Material distributed as *Lycogala exiguum* Morg. should be checked. Likewise, specimens that I have determined under that name.

PHYSARUM AENEUM R. E. Fries. A specimen was found near Pulaski, Wythe County, Virginia, in August, by Robert H. Rispaud, the nine year old son of Mr. Joseph H. Rispaud who accompanies his father on many trips, and has been successful in finding many small forms. The collection consists of a few sporangia and plasmodiocarps on a single leaf. The lime in the capillitium is much paler than usual. N. Y. B. G. No. *4997*.

PHYSARUM ALBESCENS Macbr. A fine collection, on plant stems, was made by J. W. Thomson in Juneau County, Wisconsin, in August 1937. The sporangia are sessile, pale in color, and with few traces of the usual hypothallus. The numerous, large, branching lime-knots in the capillitium are pale yellow, almost white. The spores are purplish-brown, not dark, spinulose, and measure 10–12 μ diam. N. Y. B. G. No. *8970*.

PHYSARUM BOGORIENSE Racib. We have found this species repeatedly in New York, Pennsylvania, Virginia, North Carolina, and Quebec, so it is well distributed in eastern North America. Colonies here are small, not like the large ones found in the tropics, and the dehiscence into reflexed lobes is not so conspicuous. It is often associated with *Physarum bivalve* Pers., and distinguished

therefrom by the yellow or brown color and the rounded plasmodiocarps on narrow bases. The spores are usually paler and smaller than those of *P. bivalve*. From *Physarum aeneum* R. E. Fries it is separated by the white lime in the capillitium which is yellow or brown in *P. aeneum*. Many specimens in the Herbarium of the New York Botanical Garden.

PHYSARUM LEUCOPUS Link. The species is rather common. We have found it frequently in the past, and during the season of 1939 in Swain County, North Carolina, Wythe County, Virginia, and Long Island, New York. It forms small colonies and is often associated with *Didymium squamulosum* (Alb. & Schw.) Fries which it resembles to the unaided eye. It should be searched for in old leaf piles where leaf species are fruiting in abundance. Our practice when such are found is to take all leaves with sporangia, and without examination place them into a box, to be sorted out after our return. By this we save time in the field and occasionally find something worth while in the box which might have been overlooked otherwise. The stalk of *P. leucopus* is usually furrowed, white, short, stout, and tapering. It may be at times longer, thinner, of equal thickness, or yellowish. The circular hypothallus may be absent. The main characters which distinguish it from *Physarum globuliferum* (Bull.) Pers. are the loose, lax capillitium and the absence of a defined columella. Many specimens in the Herbarium of the New York Botanical Garden.

PHYSARUM MEGALOSPORUM Macbr. The form was first described by Sturgis (Mycologia **9**: 323–324. 1917) as *Physarum melanospermum*. The latter name was used by Persoon (in Roemer N. Mag. Bot. 88. 1794) for what is now known as *Didymium melanospermum* (Pers.) Macbr. so that it cannot be used again and must be superseded by Macbride's name. The species has been found, apparently, heretofore only in Colorado by Bethel or Sturgis. It is refreshing, therefore, to note its collection again, this time in Geary County, Kansas, by Travis E. Brooks in August 1938. The development is typical with flattened, centrally depressed sporangia on stout, black stalks, and very dark spores 12–13 μ diam. having a paler area. Some of the stalks are yellowish, and some of the sporangia subglobose or bolster-shaped, but not sessile.

Macbride, in the North American Slime-moulds, and Macbride and Martin in the Myxomycetes describe and key the species as primarily sessile. This is not so and creates confusion as to what the species really is and also doubts as to whether it is the same as *P. melanospermum*, because Sturgis described his species as a stalked one. The specimens of Sturgis are in the Herbarium of the New York Botanical Garden and show clearly that the species forms stipitate sporangia primarily, and while it cannot be denied that there may be sessile sporangia in some other collection, this would be of secondary importance. N. Y. B. G. No. *9191*.

Physarum superbum nom. nov. The name is proposed for the form represented by figures *a* (Philadelphia) on plate 22 in the second and third editions of the Lister Monograph. In the second edition it was regarded as *Physarum variabile* Rex var. *sessile*, and in the third, as *Physarum sessile* Brandza.

Brandza (Ann. Sc. de l'Univ. Jassy **11**: 116–117. 1921) proposed the name *Physarum sessile* to cover two forms in Roumania, a white one and a yellow one, including therewith *P. variabile* var. *sessile*. Later (Bull. Soc. Myc. Fr. **44**: 260–262. 1929), he separated the white one as *P. sessile*, and proposed *Physarum aureum* for the yellow one. The white form was distributed by Brandza in exsiccatae in 1920 as *P. variabile* var. *sessile*, and again in 1922 as *P. sessile*. These specimens are here and consist of white cylindrical plasmodiocarps and globose sporangia with pale, smooth spores 7–8 μ diam. They are closely related to *Physarum cinereum* (Batsch) Pers., and probably only phases thereof. Whether or not the yellow form, later named *P. aureum*, is the same as the one under discussion here is immaterial as Brandza's name cannot be used. *Physarum aureum* (Pers. in Roemer N. Mag. Bot. 88. 1794) is already in use for a form now regarded as synonymous with *Physarum viride* (Bull.) Pers.

There is in the former collection of Dr. W. C. Sturgis, now in the Herbarium of the New York Botanical Garden, a specimen collected by the late Hugo Bilgram at Philadelphia in August–September 1900 which is probably a part of the same material used by Lister for his figures *a* on plate 22. The specimen is accompanied by a letter from Mr. Lister to Dr. Sturgis dated February 3, 1901, in which he mentions interesting specimens received from

Mr. Bilgram, and that he had been drawing them all. He refers to a letter he sent to Mr. Bilgram, a copy of which letter dated February 2, 1901, also accompanies the specimen. This letter comments on various specimens received, including one which he names *Physarum variabile* var. *sessile* and which is clearly reconciled with the specimen in the former collection of Sturgis. There are also in the Herbarium of the New York Botanical Garden seven other collections made personally on Long Island, New York, and in the Great Smoky Mountains region of North Carolina and Tennessee, and another from North Carolina found by the late Prof. R. Thaxter. All are identical with the Philadelphia collection of Bilgram and figures *a* on plate 22 of Lister, except that two are neither well developed nor normal.

The fructification, on leaves, is plasmodiocarpous with abbreviated plasmodiocarps down to sporangial size. The plasmodiocarps are annular, sinuose, netted, branched, or straight up to 12 mm. in length or more. The color is yellow to orange-red. The plasmodiocarps are not cylindrical in cross-section, but more or less laterally compressed and on broad bases. The sporangium-wall has heavy deposits of yellow or orange-yellow lime granules, often unevenly distributed, or scanty in the lower part, presenting a mottled appearance. The lime-knots in the capillitium are abundant, angular, irregular or branching, white or pale yellow, sometimes densely aggregated in the center. The spores are somewhat pale brownish-lilac, minutely and evenly spinulose, 7–8.5 μ diam. The characters are remarkably uniform throughout the collections.

These plasmodiocarps cannot be associated with *P. variabile* (or *Physarum sulphureum* Alb. & Schw. as now regarded) because of the habit, color, and smaller spores. There are sessile sporangia and plasmodiocarps of *P. sulphureum* (Mycologia **31**: 346–348. 1939) which are like figure *b* on Lister's plate 22, and have larger spores. They are not *P. sessile* Brandza, obviously, an entirely different form. I doubt that *P. aureum* Brandza belongs with them as it is described with spores 10–12 μ diam., and figured with cylindrical plasmodiocarps. The beautiful form on Lister's plate 22 as figure *a* requires a name that is appropriate and tenable. I propose for it, *Physarum superbum*.

Material distributed from here under one of the various names

mentioned should be corrected. N. Y. B. G. Nos. *786, 1253, 4973, 4974, 4979, 4989, 4990, 11027, 11550.*

PROTOTRICHIA METALLICA (Berk.) Massee. Rarely, if ever, reported from the eastern United States, although not uncommon in the West. It was found in August near Newfound Gap, Swain County, North Carolina, at an altitude of 4200 feet. The sporangia are much like those of *Margarita metallica* (Berk. & Br.) List. or *Dianema Harveyi* Rex, but the capillitium is different, consisting of threads wound with prominent spirals and divided at the tops into bundles of thinner threads, with attachments to the peridium at both ends. N. Y. B. G. No. *2933.*

THE NEW YORK BOTANICAL GARDEN

CONTRIBUTIONS TO THE MYCOFLORA OF BERMUDA—I

F. J. Seaver and J. M. Waterston

(with 6 figures)

During the late autumn of 1938 (November 28 to December 14) the senior author made a third visit to Bermuda in continuation of the mycological survey of the islands, initiated by The New York Botanical Garden more than a quarter of a century ago, and continued intermittently to the present time.

The first expedition, in connection with the above work, was made in the year 1912, covering almost exactly the same seasonal dates as our recent one. Thus the third visit represented a twenty-sixth anniversary of the first. At the time of the first visit scarcely more than a score of fungi were known from the islands, and the place had the reputation of being almost barren of this particular form of plant life. Consequently the voyage was undertaken with some misgivings. These fears, however, proved to be groundless for as a result of this first short visit, the number of known species of fungi was increased to considerably more than a hundred, a list of which was published in the Memoirs of The New York Botanical Garden in August, 1916, and constituted the first extensive list published of the fungi of the islands. A few new species were included. The results of the second expedition, in company with Professor H. H. Whetzel, are left out of consideration since most of the material collected on this occasion (1926) is in Cornell University, and for the most part unworked.

The remoteness of these islands, together with the fact that they have apparently never been connected with any other existing body of land, adds interest to the study of their land flora. Although the fungi cannot be said to be abundant, on critical study one is impressed *first* by the number of species found there which are not known to occur in other parts of the world, although we do not usually think of the fungi as being restricted to very limited

areas, and *second* by the number of species occurring abundantly in Bermuda which are known but rarely in other parts of the world. The fungi seem to defy all known rules of distribution, and follow a course of their own. Some of the idiosyncracies in the distribution of the fungi will be discussed in the present paper. In doing this we will first consider two European species which were reported from Bermuda on our first visit, and which on our late return were re-collected and found to be thoroughly established, and in one case exceedingly abundant but concerning which little is known in Europe and nothing at all on the mainland of North America.

EUROPEAN SPECIES

LAMPROSPORA PLANCHONIS (Dun.) Seaver. This species was originally described from material collected in France and published in 1887. We have seen no further mention of the fungus from Europe, but in 1912 it was found to be very common in Bermuda. In 1914 Dr. R. Maire collected the species in North Africa and distributed it under the name *Plicaria Planchonis* (Dun.) Boud. in his Mycotheca Boreali-Africana no. *192*. In Bermuda this fungus is ubiquitous and so abundant on sandy soil and sand dunes that one finds himself wondering why nature could not have made more different kinds of cup-fungi there instead of making so many of the same kind, forgetting for the time that we were collecting a fungus that was rare in Europe and entirely unknown in the New World unless Bermuda be regarded as part of the New World.

There has always been some confusion between this species and *Ascobolus Persoonii* Crouan, and Saccardo intimates that the two may be the same fungus. If so, this might partly account for its apparent rarity in Europe, but still does not explain the fact that it has never been found on the mainland of North America, although the cup which reaches a diameter of nearly two centimeters could not be easily overlooked by students of the group if it occurred here, and certainly not if it were anywhere as abundant as it is in Bermuda. Since these islands have grown up in mid-ocean, it is difficult to account for these peculiarities in the distribution of certain species.

FIG. 1. *Trichoglossum Wrightii.*

PSEUDOPITHYELLA MINUSCULA (Boud. & Torrend) Seaver (FIG. 6). This species was described under the name *Sarcoscypha minuscula* Boud. & Torrend, from material collected in Portugal on the dead foliage of cedar. It was published in 1911, just one year before the senior author collected it on dead foliage of the endemic cedar, *Juniperus bermudiana* L., in Bermuda. Although no further mention of the species has been noted in Europe, on our recent visit to Bermuda the species was again collected and, while apparently common and thoroughly established, it is not as abundant as the preceding form, and less conspicuous because of its small size.

In the senior author's North American Cup-fungi this was made the type of a new genus characterized by having a protruding ring surrounding the ascus near the tip, a character which has never been observed in any other species of cup-fungi studied. While minute in size the fungus partly overcomes this handicap by assuming a bright scarlet color. The generic name is suggested by its resemblance to *Pithya*, with which it is often associated and which it outwardly resembles, except in color.

Here again we have a rare European species well established and common in Bermuda, but not known from any other part of the world. We might assume from these illustrations that possibly Bermuda had at some remote time been connected with Europe if we did not know better, and were it not for the fact that we have rare North American species which are apparently common in Bermuda but on the other hand unknown in Europe. Two of these will be mentioned as illustrations.

NORTH AMERICAN SPECIES

OPHIONECTRIA CYLINDROTHECIA Seaver (FIG. 4, lower). This species was described by the senior author in his monograph of the North American Hypocreales (Mycologia 1: 70. 1909). The species has never again been encountered in continental North America and is not known in Europe unless, as sometimes happens, it has been described under some other name. The type species was described from material collected on old stalks of corn, *Zea Mays* L., in Ohio, exact date not given. In 1922 the senior writer received from H. H. Whetzel, then temporarily located in Ber-

FIG. 2. *Stictis Coccolobii.*
Gnomonia pulcherrima.

muda, specimens on the petiole of Bermuda palmetto, *Sabal bermudana* L. H. Bailey, which were at once recognized as his own species named above. During our recent visit the species was again twice collected on the same substratum. Thus a species described more than a quarter of a century ago from continental North America on monocotyledonous stems has been encountered three times on similar substratum in Bermuda, but has never again been found on the mainland. This particular case might be explained by the fact that the fungus is minute and inconspicuous and has escaped notice. But the same explanation will not hold for some other forms.

TORULA DIVERSA Cooke (FIG. 5). This fungus was described by M. C. Cooke from material collected on the leaves of *Agave* at Darien, Ga., published in Grevillea in 1878, and distributed by H. W. Ravenel in his Fungi Americani Exsiccati no. *283*. The fungus forms sooty spots conspicuous enough to be easily seen by anyone interested in the study of parasitic fungi, yet so far as can be discovered this fungus described more than sixty years ago has not been encountered again in continental North America, but was found to be fairly abundant on *Agave* leaves in Bermuda during the past winter. Other examples might be given, but these will serve to illustrate the unique character of the mycoflora of Bermuda.

ENDEMIC SPECIES

Because of the ease with which the spores of the fungi may be blown about, we do not usually think of them as being restricted to small areas but nevertheless several species have been described from the islands which must be regarded as endemic until they have been discovered in some other region. Two such species described by the senior writer in 1916 from material collected in 1912 deserve special mention.

NECTRIA LANTANAE Seaver. This species was first found on the under side of fallen leaves of *Lantana odorata* L. After so long a time the writers during the last winter were anxious to know whether the fungus continued to recur on the leaves of this host, or whether it was just a chance infection. A preliminary search revealed nothing and we had almost given up hope of rediscovering

this fungus when on December 8, while collecting on St. David's Island, the senior writer casually picked up a handful of fallen *Lantana* leaves and found several of them dotted over with the red perithecia of the desired *Nectria* which proved to be fairly abundant. A later collection was made at Grape Bay, and still later the junior author found it in his own dooryard in Hamilton. Thus after twenty-seven years this little fungus which was first collected near Harrington Sound was located in three other stations. *Lantana odorata* is a shrub which was introduced into Bermuda from the Bahamas prior to 1800, and is now widely distributed. It is difficult to believe that this fungus occurs persistently on the leaves of this host in Bermuda, and not on the same host in other parts of the world. Yet the fact remains that it has not been found elsewhere and must remain an endemic species until it has been discovered in some other part of the world as it doubtless will be.

CALONECTRIA UMBELLIFERARUM Seaver. Another novelty described by the senior writer in his first report of the fungi of the islands occurred on the stems of fennel, *Foeniculum vulgare* Gaertn., an introduced herbaceous plant which has escaped from cultivation and become widely disseminated in the islands. As in the preceding case, the fungus was at first looked for without results. Finally, on December 9, it was located in Smith's Parish. Later the junior author sent other specimens on the same host from Somerset, again showing that the fungus was well established on this host in Bermuda, but up to date has not been found on the same host outside of Bermuda. It is not unlikely that if the same diligent search had been made for these two minute fungi on the same hosts outside of Bermuda they might be found. But the fact remains that this has not yet been done.

SCLERODERMA BERMUDENSE Coker. During the second visit to Bermuda the senior author observed the remains of a fairly large *Geaster*-like fungus on the sands of the south shore. Closer observation showed that this puffball matured entirely submerged, first appearing as a crack in the sand. The outer covering of the puffball splits into several star-like rays which roll back and the fruiting body literally lifts itself as by its bootstraps out of the sand. The spore mass is then quickly blown away and all we

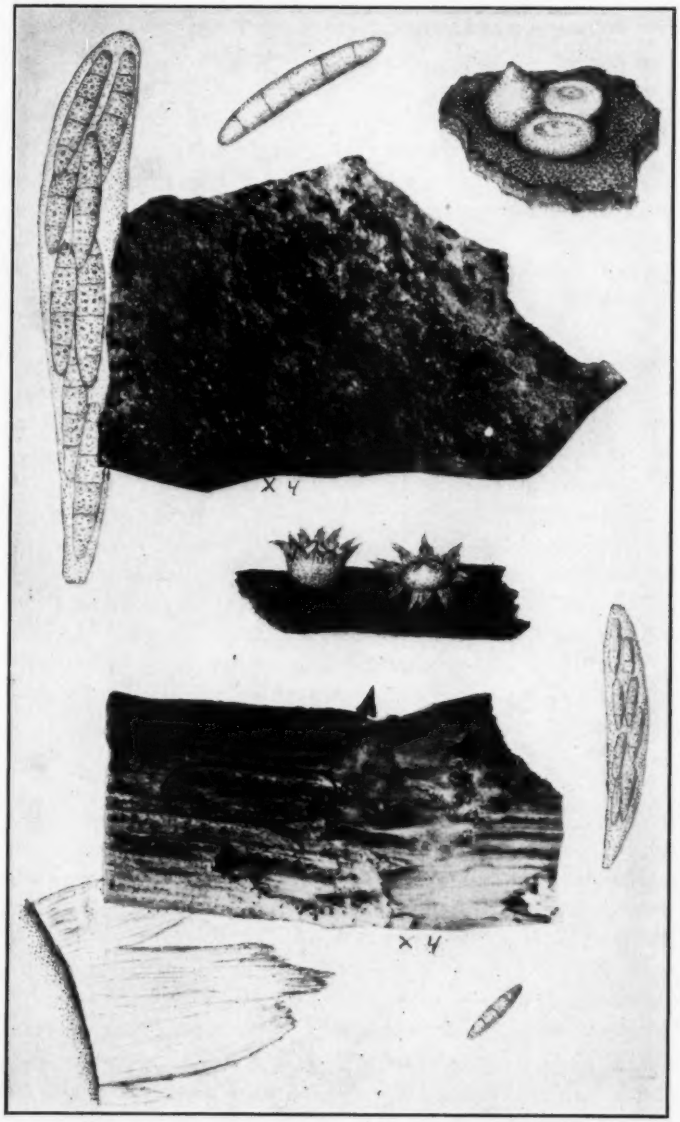


FIG. 3. *Calonectria Crescentiae.*
Calonectria fimbriata.

have left is the outer covering which would appear to the casual observer like a piece of dried leather. It is very difficult to find one of these balls before opening since at that time they are entirely hidden.

On our late visit to the islands a large collection of this peculiar fungus was made near the Elbow Beach Hotel and submitted to Dr. W. C. Coker of the University of North Carolina, an expert in this particular group, for critical study. He pronounced it a new species and described it under the name given above (Mycologia **31**: 624. 1939). It is claimed to be the only known *Scleroderma* which matures entirely under ground. Unlike the two preceding species, this fungus is not too small to be seen by the casual observer. If a palm and a cedar tree could become so modified under conditions of isolation that they come to be regarded as distinct species, why could not the same thing happen to a puffball, as seems to have been the case with this species?

HUMARINA WATERSTONII Seaver. This is one of our most interesting late collections. The species is unusual since it is the only member of the genus encountered which grows exclusively on the seeds of the higher plants. Since the fungus seems to be restricted to the seeds of its host, the Chinese fan-palm *Livistona chinensis* R. Br., it is not unlikely that the fungus might be found where the palm is native. However, no such fungus has been reported and it must be regarded as endemic to Bermuda.

ADDITIONS TO THE FLORA

During our recent survey of the islands, a goodly number of species, in addition to those mentioned above, were collected which had not been obtained on our previous excursions, notwithstanding the fact that two of these visits covered exactly the same seasonal dates. This is due in part to the sporadic occurrence of some of the fungi, and in part to the fact that on account of their obscure character it is impossible to find all that occur at any one time. A number of these appear to be new to science. While the collection has not all been studied, we list below new and noteworthy species that have thus far been determined, and it is expected in later papers to publish from time to time additional discoveries.

NEW SPECIES

PEZIZALES (INOPERCULATES)

Helotium atrosubiculatum sp. nov.

Apothecia thickly gregarious, occasionally forming congested masses, stipitate gradually expanding above becoming shallow cup-shaped, occasionally convoluted 2–4 mm. in diameter and about 2 mm. high, externally grayish-brown and pruinose; hymenium concave, whitish even or in larger specimens convoluted; asci clavate reaching a length of 60 μ and a diameter of 6 μ; spores ellipsoid, each containing two oil-drops 2–2.5 $\times$ 6–7 μ; paraphyses filiform, about 1 μ in diameter.

Apotheciis gregariis, stipitatis, applanatis, griseis vel brunneis, 2–4 mm. diam., 2 mm. alt.; hymenio concavo, subalbido; ascis clavatis, 60 $\mu \times 6 \mu$; sporis ellipsoideis, 2–2.5 $\times$ 6–7 μ; paraphysibus filiformibus, 1 μ diam.

On the blackened surface of leaves of *Archontophoenix Alexandrae* Wendel & Drude, rotting on the ground, *71*.

Type collected at Hungry Bay, December 2, 1938. The black subiculum seems to be a constant character in this species. The base of the stem is also black and easily detached near the base leaving disc-like scars which themselves look like minute discomycetes.

Dasyscypha fasciculata sp. nov.

Apothecia thickly gregarious, occurring singly or more often in dense fasciculate clumps, several apparently springing from the same base and so closely compact that they appear to be one compound fruit body, short-stipitate, externally clothed with a dense covering of white hairs, the clumps scarcely exceeding 1 mm. in diameter, the individual apothecia much less; hymenium concave, pale-orange; hairs flexuous, hyaline, externally roughened, about 2 μ in diameter; asci clavate, reaching a length of 35–40 μ and a diameter of 4 μ, 8-spored; spores minute, fusoid, hyaline, 1.5 $\times$ 6 μ; paraphyses filiform semi-acute but scarcely lanceolate.

Apotheciis gregariis aut fasciculatis, breve stipitatis, extus pilis albis tectis, vix 1 mm. diam.; hymenio concavo, flavo-aurantio; pilis flexuosis, hyalinis, 2 μ diam.; ascis clavatis, 35–40 $\mu \times 4 \mu$; 8-sporis; sporis fusiformibus hyalinis, 1.5 $\times$ 6 μ; paraphysibus filiformibus aut sublanceolatis.

Type collected on rotten stumps of olive tree *Olea europaea* L., *45*. Walsingham, Nov. 30, 1938.

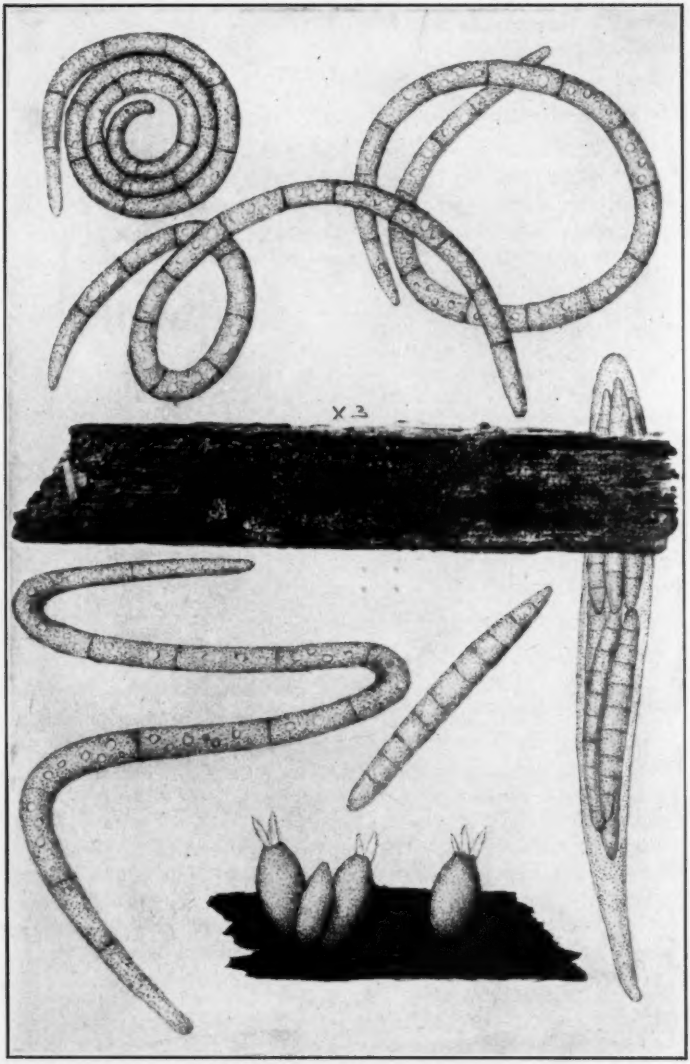


FIG. 4. *Helicomyces roseus.*
Ophionectria cylindrothecia.

Gorgoniceps confluens sp. nov.

Apothecia gregarious, occasionally crowded and several fusing together, sessile or contracted into a very short stem-like base, whitish or bluish-white, remaining light-colored or becoming darker when dried, reaching a diameter of .5 mm. soft and waxy; hymenium plane or slightly convex, similar in color to the outside of the apothecium; asci broad-clavate, with a very short stem-like base, attenuated at the apex, reaching a length of 100 μ and a diameter of 14 μ, 8-spored; spores bunched together and overlapping, cylindric, fusoid or subclavate, straight or more often curved or double curved, becoming 7-septate, 5–7 $\times$ 40–45 μ; paraphyses filiform, about 2 μ in diameter.

Apotheciis gregariis, sessilis aut subsessilis, albidis aut subcaeruleis, .5 mm. diam.; hymenio plano vel convexo; ascis late clavatis, substipitatis, 100 μ $\times$ 14 μ, 8-sporis; sporis cylindraceis aut subclavatis, rectis aut flexuosis, 7-septatis 5–7 $\times$ 40–45 μ; paraphysibus filiformibus 2 μ diam.

On rotten wood and on palm stems.

Type collected in Bermuda by Stewardson Brown, N. L. Britton and Fred J. Seaver (No. *1487*) Nov. 29–Dec. 14, 1929. This is very similar to *G. iowensis* Rehm which was described from material collected by the author in Iowa. The spores of the Bermuda specimens seem to be larger. Also collected in Paget Marsh on stems of native palmetto, *Sabal bermudana* L. H. Bailey *62*.

PHACIDIALES

STICTIDACEAE

Stictis Coccolobii sp. nov. (FIG. 2, upper)

Apothecia on either side of the leaf at first immersed, the epidermis finally rolling back in about five stellate lobes which are white on the inside; hymenium freely exposed at maturity not deeply immersed, whitish or with a slightly olive tint, reaching a diameter of about .5–.75 mm.; asci clavate, 8-spored, reaching a length of 80 μ and a diameter of 8 μ; spores filiform reaching a length of 70–75 μ and a diameter of 2 μ, becoming many-septate; paraphyses filiform slender.

Subgregarium, innatum dein epidermide in lacinias 5 vel plures aequales acutas fissa erumpens; hymenio albido vel leniter olivaceo, .5–.75 mm. diam.; ascis clavatis 8-sporis, 80 μ $\times$ 8 μ; sporis filiformibus, 70–75 μ $\times$ 2 μ, multiseptatis; paraphysibus filiformibus.

On leaves of *Coccolobis uvifera* (L.) Jacq. lying on the ground.

Type locality: Grape Bay, *13, 196.*

The spores of this species are only half as long as those of *Stictis radiata* (L.) Pers., and the apothecia are much more shallow than those of the latter species.

Stictis lophodermioides sp. nov.

Apothecia thickly gregarious, erumpent, usually elongated, .5 to 1 mm. long and usually one-third as wide, often several coalesced, the ruptured epidermis pallid, whitish within, hymenium yellowish; asci clavate, reaching a length of 50–60 μ and a diameter of 8 μ; spores filiform slender, nearly as long as the ascus.

Apotheciis gregariis, erumpentibus, elongatis, .5–1 mm. long.; hymenio flavo; ascis clavatis, 50–60 $\mu \times 8\,\mu$; sporis filiformibus.

On sheaths of grass (*Stenotaphrum*?).

Type collected about Harrington Sound by Brown, Britton and Seaver (No. *1469*) Nov. 29–Dec. 14, 1912.

This was doubtfully recorded as *Stictis graminum* Desm., but on more careful study was found to differ. In form it suggests a *Lophodermium*, but in other characters it is more like a *Stictis*, hence the name.

SPHAERIALES

Ascospora Citharexyli sp. nov.

Perithecia thickly scattered over both the surfaces of the leaves of the host or occasionally collected in groups, erumpent often becoming semisuperficial subglobose, black; asci clavate reaching a length of 50–60 μ and a diameter of 12 μ, 8-spored; spores irregularly 2-seriate, subhyaline, fusoid, strongly swollen in the center with both ends narrowed, usually containing 1 large oil-drop 8×16–$20\,\mu$.

Peritheciis sparsis erumpentibus dein semisuperficialis, subglobosis, atris; ascis clavatis, 50–60 $\mu \times 12\,\mu$, 8-sporis; sporis subdistichis, subfusiformibus 8×16–$20\,\mu$ subhyalinis.

On dead leaves of fiddlewood *Citharexylum spinosum* L.

Type material collected at Somerset Dec. 17, 1938 by J. M. Waterston *212.*

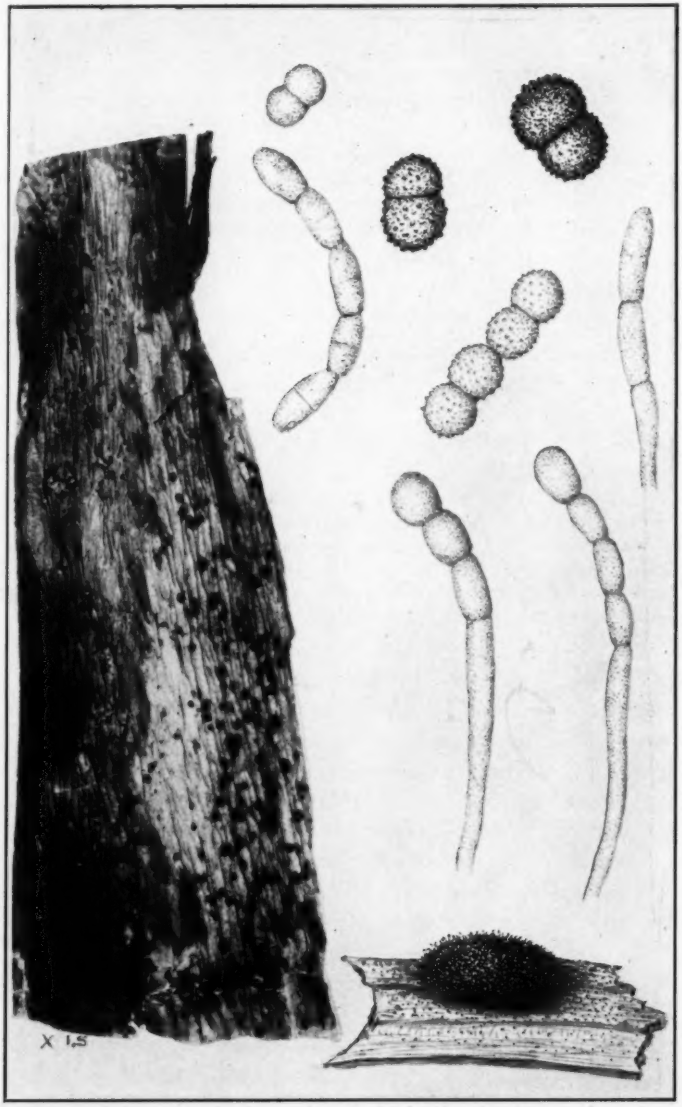


FIG. 5. *Torula diversa.*

Gnomonia pulcherrima sp. nov. (FIG. 2, lower)

Perithecia thickly gregarious, entirely buried in the substratum with the long beak protruding, surrounded at the point of exit with a yellowish granular mass consisting largely of angular crystals, the individual perithecia about 250 μ in diameter, the beak about 400 μ long and about 80 μ thick, the walls olive-green in color; asci clavate reaching a length of 50 μ, and a diameter of 8 μ; spores irregularly 2-seriate, fusoid, pale-greenish becoming 1-septate and slightly constricted, containing 3 or 4 oil drops about 12 $\times$ 4 μ.

Perithecis dense gregariis immersis, 250 μ diam.; ostiolis exsertis 400 $\times$ 80 μ diam., olivaceis; ascis clavatis, 50 μ $\times$ 8 μ; sporis subdistichis, subfusiformibus olivaceis, uniseptatis, 12 μ $\times$ 4 μ, leviter constrictis.

Type collected on petioles and midribs of leaves of *Coccolobis uvifera* (L.) Jacq. lying on the ground, Hungry Bay *82*.

Penzigia bermudensis J. H. Miller, sp. nov.

Stromata gregaria vel confluentia, subglobosa, 1–.5 $\times$ .5 mm., apicis convexis vel applanatis, inferne constricta; ectostromatibus atro-brunneis vel nigris, levigatis; entostromatibus suberosa-lignosis albis; perithecis 1–4 in quoque stromate, globosis, 300–400 μ in diam.; ostiolis minutis, papillatis; ascis cylindraceis (par. spor.) 50–70 μ longis, attenuatis stipitis, 45–65 μ longis; 8-sporis; sporis monostichis, lato-ellipsoideis, apicis obtusis, atro-brunneis, 8–10 $\times$ 6–8 μ; paraphysibus numerosis, ramosis, filiformis. Ad ligna decorticata. *38B*. Walsingham, Nov. 30.

This is one of the intermediate species in the Xylariaceae. Macroscopically it resembles somewhat *Rosellinia*, but differs from most species of that genus in possessing a fleshy-leathery outer stromatic crust instead of the carbonous one, and in the white stroma in which the perithecia are embedded. This internal tissue, common in *Xylaria* species, is characteristic of *Penzigia*.

There are other species with few perithecia in the stroma such as *Penzigia frustulosa* (Berk. & Curt.) Mill. and *P. Kellermanii* (Rehm) Mill. in the United States, and *P. conostoma* (Mont.) Mill. in South America. These all differ from the Bermuda fungus in spore dimensions, measuring respectively 5–6 $\times$ 2.5–3 μ, 25 $\times$ 11–14 μ, and 22–28 $\times$ 8–12 μ.

The *Hypoxylon* species that have this general appearance are *H. confluens* (Tode ex Fries) Cooke, and *H. udum* Fries in Europe, and *H. regale* Morgan in this country. All of these have much larger spores and all lack the fleshy-leathery white subperithecial stroma.

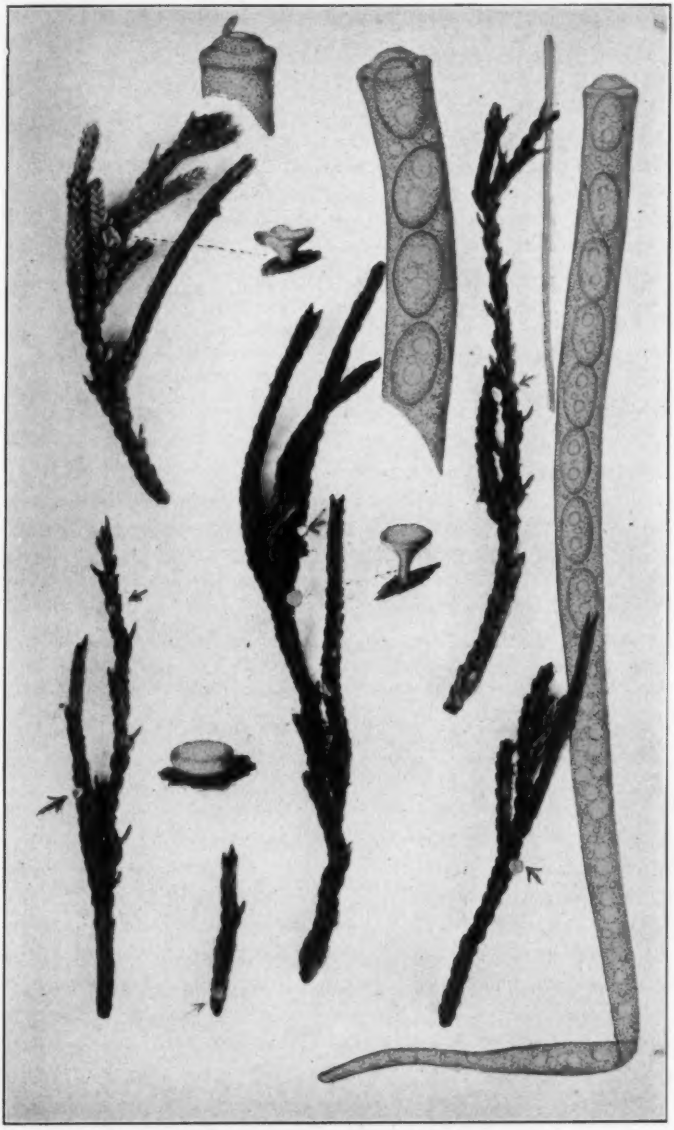


FIG. 6. *Pseudopithyella minuscula.*

HYPOCREALES

Calonectria Crescentiae sp. nov. (FIG. 3, upper)

Perithecia thickly gregarious or often closely congested but without trace of stroma at first globose, when dried out collapsing and becoming pezizoid resembling in size and form *Nectria Peziza* (Tode) Fries; asci clavate, reaching a length of 80 μ and a diameter of 10 μ; spores partially 2-seriate, fusoid slightly curved, variable in size but reaching a length of 30 μ and a diameter of 6 μ, granular within, becoming 3-septate and slightly constricted at the septa, hyaline; paraphyses indefinite.

Peritheciis dense gregariis, subsphaeroideis, siccis supra depressis, pezizoideis; ascis clavatis, 80 $\mu \times 10\ \mu$; sporis subdistichis, subfusiformibus, curvulis, 3-septatis, leviter constrictis.

Type collected on a weathered shell or fruit rind of the calabash, *Crescentia Cujete* L., in Smith's Parish, Dec. 9, 1938.

Calonectria fimbriata sp. nov.

Perithecia minute occurring singly or in small congested clusters, pale orange, subglobose collapsing vertically, showing a distinct fringe-like or often stellate margin; asci clavate reaching a length of 36 μ and a diameter of 6 μ; 8-spored; spores irregularly 2-seriate fusoid, 3 $\times$ 12–14 μ becoming 3-septate, hyaline or subhyaline.

Peritheciis minutis solitariis vel congestis subglobosis dein pezizoideis palidoaurantiis, margine fimbriato vel stellato; ascis clavatis 6 $\times$ 36 μ, octo-8-sporiis; sporis subdistichis fusoideis, subhyaliniis dein 3-septatis.

On dead stems of *Foeniculum vulgare* Gaertn.

Distinguished from *Calonectria Umbelliferarum* Seaver by the minute fringed perithecia and the much smaller spores.

NOTEWORTHY SPECIES

BASIDIOMYCETES

AGARICUS CAMPESTRIS L. The common field mushroom was found well established in a pasture on Kitchener's (Hinson) Island when visited on December 5, 1938. Strange as it may seem, this well known species had not previously been recorded from the islands, and has so far as known up to date been observed only on the one island.

CLAVARIA VERMICULATA Mich. This species was determined by Dr. W. C. Coker as above, with *C. vermicularis* Fries as a syno-

nym. The fungus was first seen on the hillside back of the Hospital Station, Paget East, and is the only *Clavaria* so far reported from Bermuda. It seemed to be rather common during the winter of 1938, having been collected in St. David's Island *149*; in Smith's Parish *165, 179*; and in Hamilton *189*, although it had not been seen on either of the two previous visits, both of which were made during the same season of the year.

LYCOGALOPSIS SOLMSII E. Fischer. This small puffball was collected in the Walsingham region on rotten wood on November 30, 1938. It was thought by us to be an immature *Lycoperdon*, but on study by Dr. W. C. Coker was referred to the above. This species was first described from material collected in Java. One collection has been reported from Honduras, and one from Panama, the Bermuda collection representing the third from this side of the world. It is thought, however, that *L. Dussii* described from Martinique, and *L. subiculosa* described by C. G. Lloyd from Porto Rico, are identical with the above. If so, the other two stations should be added to the known distribution of the species. In any case, it is a very rare puffball and its collection in Bermuda represents a wide extension of range.

ASCOMYCETES

NECTRIA SUFFULTA Berk. & Curt. This setose *Nectria* was originally described from material collected in Cuba, and has hitherto been known only from the West Indies and Mexico. Its appearance in Bermuda on rotten stumps of wild sisal, *Furcraea macrophylla* Baker, is therefore noteworthy.

LAESTADIA JUNIPERINA (Ellis) Sacc. A fungus on the dying leaves of Bermuda cedar, *Juniperus bermudiana*, appears to be the above species originally described by Ellis from material collected in Iowa on leaves of *Juniperus virginiana*. Ellis also claims that it has been found by Karsten in Finland. It may be responsible for the cedar blight so prevalent in Bermuda during recent years. Field experiment will be necessary to prove this.

TRICHOGLOSSUM WRIGHTII Durand. (FIG. 1.) This was first listed by Durand as a form of *Trichoglossum hirsutum*, based on two specimens from Cuba. Later, on collections of the senior author from Bermuda in 1912 (Britton, Brown & Seaver *1404*),

this form was raised to specific rank by Durand (Mycologia **13**: 187. 1921). This is one of the commonest species of the genus which is well represented in Bermuda, and was recollected on our recent visit by Mr. T. A. Russell and the senior author *178*.

TRYBLIDIELLA RUFULA (Spreng.) Sacc. Hawkin's Island was visited and explored on December 5, 1938. One of the noteworthy collections made was the above species which, although common in both tropical and temperate regions, had not previously been recorded from Bermuda. On this occasion it was found to be very abundant on wild *Mimosa* (*Leucaena glauca* (L.) Benth.) *140*. Although abundant there it has to date been found only on the one island. It is an interesting coincidence that this fungus has been reported on the same host from the Hawaiian Islands by Miss Cash (Mycologia **30**: 101. 1938).

FUNGI IMPERFECTI

A number of fungi belonging in the present group have been collected, but most of them determined only as far as the genus. In addition to the one mentioned in the introductory paragraphs of the present paper, one other deserves special mention as follows:

HELICOMYCES ROSEUS Link. (FIG. 4, upper.) Apparently common in Bermuda, having several times been collected, and always on the stems of the native endemic palm *Sabal bermudana* L. H. Bailey. The fungus is of especial interest because of its association with *Ophionectria cylindrothecia,* reported elsewhere in this paper. During the past winter several collections of this ascomycete were obtained. Close examination showed every collection of the ascomycete to be accompanied by the *Helicomyces,* which was determined by Dr. D. H. Linder as above. Finding the *Helicomyces* always associated with the *Ophionectria* in our own collections prompted a re-examination of the Whetzel collection obtained sixteen years before, and it was also found to be accompanied by the same *Helicomyces.* This again suggested a more careful study of the type material of the *Ophionectria* collected in Ohio more than thirty years ago (the exact date not recorded), and again the *Ophionectria* was found to occur with the *Helicomyces,* but had been overlooked when the fungus was described, or at least not regarded as of any importance. Thus

every collection of *Ophionectria cylindrothecia* known is accompanied by the above species of *Helicomyces,* and we predict that the latter will be found to represent the conidial stage of the former. Attempts to germinate the ascospores showed them not to be viable. This connection should be studied from fresh material in the field.

NEW TO BERMUDA

In addition to the above mentioned species the following were collected and reported for the first time from Bermuda. This list includes only those for which specific determinations have been made. Much of the material is still in the process of study: *Geaster radicans* Berk. & Curt.; *Lycoperdon Wrightii* Berk. & Curt.; *Lycogalopsis Solmsii* Ed. Fischer; *Solenia candida* Pers.; *Sphaerobolus Carpobolus* L.; *Ascobolus magnificus* Dodge; *Ascophanus granulatus* (Bull.) Speg.; *Orbilia coccinella* (Sommerf.) Karst.; *Patella melaloma* (Alb. & Schw.) Seaver; *Patella cubensis* (Berk. & Curt.) Seaver; *Peziza vesiculosa* Bull.; *Diatrypella favacea* (Fries) Ces. & DeNot.; *Eutypella fraxinicola* (Cooke & Peck) Sacc.; *Herpotrichia albidostoma* (Peck) Sacc.; *Hypocrea sulphurea* (Schw.) Sacc.; *Hypoxylon exutans* Cooke; *Hypoxylon jecorinum* Berk. & Br.; *Hypoxylon stygium* (Lév.) Sacc.; *Megalonectria pseudotrichia* (Schw.) Speg. conidia only; *Nectria episphaeria* (Tode) Fries; *Nectria rhytidospora* Pat.; *Nectria ochroleuca* (Schw.) Berk.; *Rosellinia aquila* (Fries) Ces. & DeNot.; *Acrostalagmus cinnabarinus* Corda; *Monilia aureofulva* Cooke & Ellis; *Synsporium biguttatum* Preuss.

The authors wish to express their appreciation to the Director and other members of the staff of the Bermuda Agricultural Station for their encouragement and coöperation, and to the various mycologists who have assisted in the determination of the material collected. They also wish to thank the officials of the Furness Bermuda Line through whose coöperation this work was made possible.

THE NEW YORK BOTANICAL GARDEN
AND
DEPT. OF AGRICULTURE,
PAGET EAST, BERMUDA

A NEW HOST FOR TAPHRINA DEARNESSII AND GEOGRAPHIC DISTRIBUTION OF TAPHRINA ON NORTH AMERICAN MAPLES

ANNA E. JENKINS AND W. WINFIELD RAY

(WITH 4 FIGURES)

INTRODUCTION

Following the recent emendations of the original description of *Taphrina lethifera* (Peck) Sacc. on mountain maple (*Acer spicatum* Lam. (**1**) and the subsequent description of *T. Dearnessii* Jenkins on red maple (*A. rubrum* L.) (**4**), the writers have had occasion to study for the purpose of identification a recent specimen of *Taphrina* on mountain maple.

HISTORICAL

Among the species of *Taphrina* occurring on North American maples, the earliest species to have been described is *T. lethifera,* for which the only record yet known is the type specimen collected by Peck (**7**) in the Adirondack Mountains of New York in 1886. This species possesses the largest asci of the five species of this group. Named in the order of size of ascus, from the largest to the smallest, the other four species are as follows: *T. Aceris* (Dearn. and Barth.) Mix (**6**) on Rocky Mountain hard maple (*Acer grandidentatum* Nutt.), the description of which was also recently emended (**1**); *T. Carveri* Jenkins (**4**) on silver or white maple (*A. saccharinum* L.); the previously mentioned *T. Dearnessii* Jenkins (**4**) on red maple, and *T. Sacchari* Jenkins (**2**) on sugar maple (*A. Saccharum* Marsh.) and on black maple (*A. nigrum* Michx.). Collectively, outline drawings of the asci of these five species showing their comparative size and form are contained in the articles just cited.

TAPHRINA ON MOUNTAIN MAPLE AND ON RED MAPLE NEAR ITHACA

The specimen of *Taphrina* on mountain maple under study was collected in the vicinity of Ithaca, New York, at Labrador Lake, on June 8, 1937, by the junior writer (Ray *345*). On June 11, 1937, he collected a *Taphrina* on *Acer rubrum* both at Ringwood Preserve (Ray *350*) and along Ellis Hollow Road (Ray *351*), also in the vicinity of Ithaca.

As already indicated, *T. lethifera* on mountain maple and *T. Dearnessii* on red maple are evidently distinct, the ascus in the former species being much larger than in the latter. Peck states that *T. lethifera* may occupy part or all of the leaf, causing it to wrinkle, and that the asci covering the whole lower leaf surface may give it a glaucous appearance. He states that soon after infection the leaves turn black and sometimes all the leaves on a branch are affected, the fungus then causing a veritable blight.

While the *Taphrina* on mountain maple from the vicinity of Ithaca caused a certain amount of wrinkling and blighting of the affected leaves (FIG. 1, *A* and *B*), they were in appearance not unlike the specimens of *Taphrina* on red maple collected about the same time (FIG. 2). As will be shown presently, isolations were made from the fresh specimens of maple by the junior writer, and the resulting cultures were indistinguishable. This was before *T. Dearnessii* was described, and also before the characters of the ascus of *T. lethifera* were as well known as at present. It was at first assumed that the *Taphrina* on mountain maple was *T. lethifera,* and that on red maple the same species.

After the recent description of *Taphrina Dearnessii,* however, the writers made a critical study of the specimens from Ithaca, and compared them with the type specimen of *T. lethifera* and with authentic material of *T. Dearnessii.* In all cases the asci were entirely typical of the latter species so far as could be ascertained (FIG. 1, *C* and *D*, and FIG. 3). The asci of *T. lethifera* from the Adirondacks, were, as described, much larger than those of *T. Dearnessii* (FIG. 1, *E* and *F*). In making this comparison the writers found asci of *T. lethifera* on the upper as well as on the lower surface of the leaf, although they had not previously been so described.

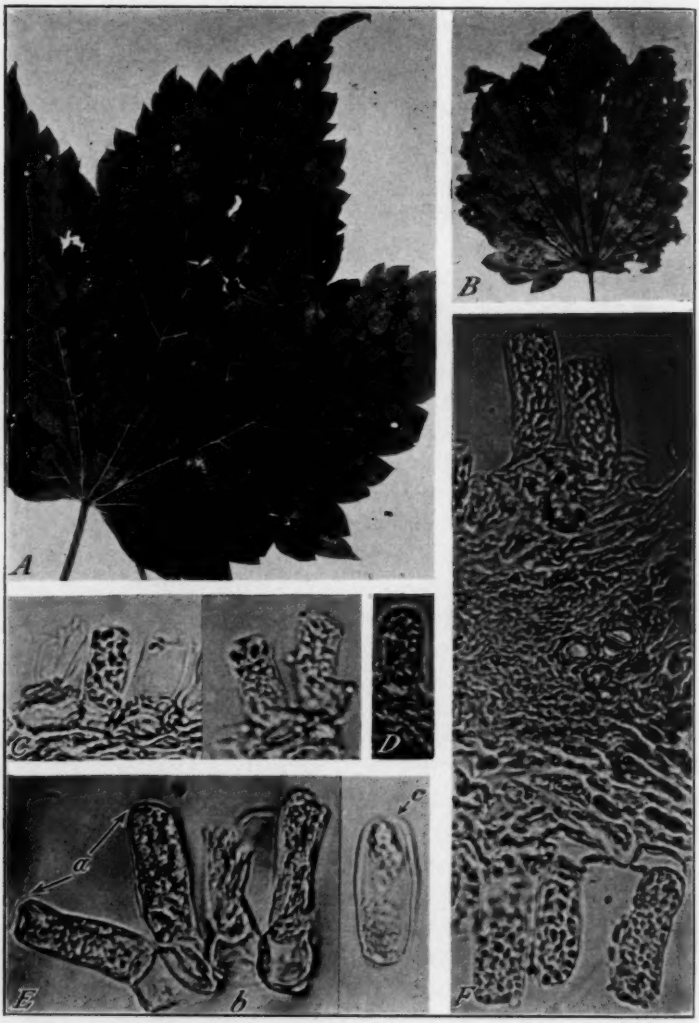


FIG. 1, *A–C. Taphrina Dearnessii* on upper (A) and lower (B) leaf surface of *Acer spicatum* from vicinity of Ithaca, New York, Ringwood Preserve, Coll. W. Winfield Ray (Ray *345*), June 8, 1937. × 1. *C*, Asci of *Taphrina Dearnessii* from the specimen shown in *A* and *B*; *D*, from infected leaf of *Acer rubrum*, Lewis County, New York, June 21, 1927. Coll. D. S. Welch and G. H. Cunningham (4); *E* and *F*, Asci of *T. lethifera*

Isolations made at Ithaca, New York, from freshly collected specimens of *Acer spicatum* and *A. rubrum* were obtained by fastening lesions to the cover of petri plates. Spores discharged readily onto the medium in the bottom of the plate. Several days later colonies appeared scattered over the plate. From some of the isolated colonies transfers were made to tubes by means of a loop. The color of the colonies on potato-dextrose agar was a light pinkish-cinnamon, according to Ridgway's (9) color chart. The fungus grew well at temperatures ranging from 0° C. to 24° C., but growth was poor at 27° C. Fresh transfers when placed in 27° C. chambers retained their viability for 40–42 days. No growth occurred at 30° C., but healthy cultures placed in a chamber at this temperature remained alive for 10–12 days. No difference could be detected between the isolates from *A. rubrum* and *A. spicatum* in their culture characteristics.

Water suspensions of spores from actively growing cultures were atomized onto young leaves of several species of *Acer* during the spring of 1937. All attempts to produce infection artificially were unsuccessful.

From the foregoing study of *Taphrina* collected on mountain maple near Ithaca in 1937, it now seems that, for the present at least, this species should be considered as *T. Dearnessii*. With *T. Sacchari* attacking both sugar maple and black maple, there are now two species of *Taphrina* each affecting two different species of *Acer*. The present identification also shows that two species of *Taphrina* may affect the same species of *Acer*.

A similar type of behavior is shown by *Taphrina* on alder (*Alnus*) (8). *Taphrina Robinsoniana* Gies. occurs on the bracts of the female catkins of *Alnus incana* (L.) Moench. and *A. rugosa* (Ehrb.) Spreng. in the summer. *Taphrina rugosa* Ray also occurs on *A. rugosa* in the early spring. *Taphrina amentorum* (Sad.) Rost. occurs in Alaska on *A. rubra* Bong. (*A. oregona* Nutt.) and in Europe on *A. glutinosa* Gaertn. The female catkins of *A. rubra* in Oregon are also attacked by *T. occidentalis* Ray, while a new species, *T. macrophylla* Ray in litt., causes leaf-curl

on *Acer spicatum*, Elizabethtown, Essex County, New York, June 1886, C. H. Peck (Type); *a*, asci, *b*, basal cells. All × 500. Photographs in *A* and *B*, by W. R. Fisher, the others by M. L. F. Foubert.

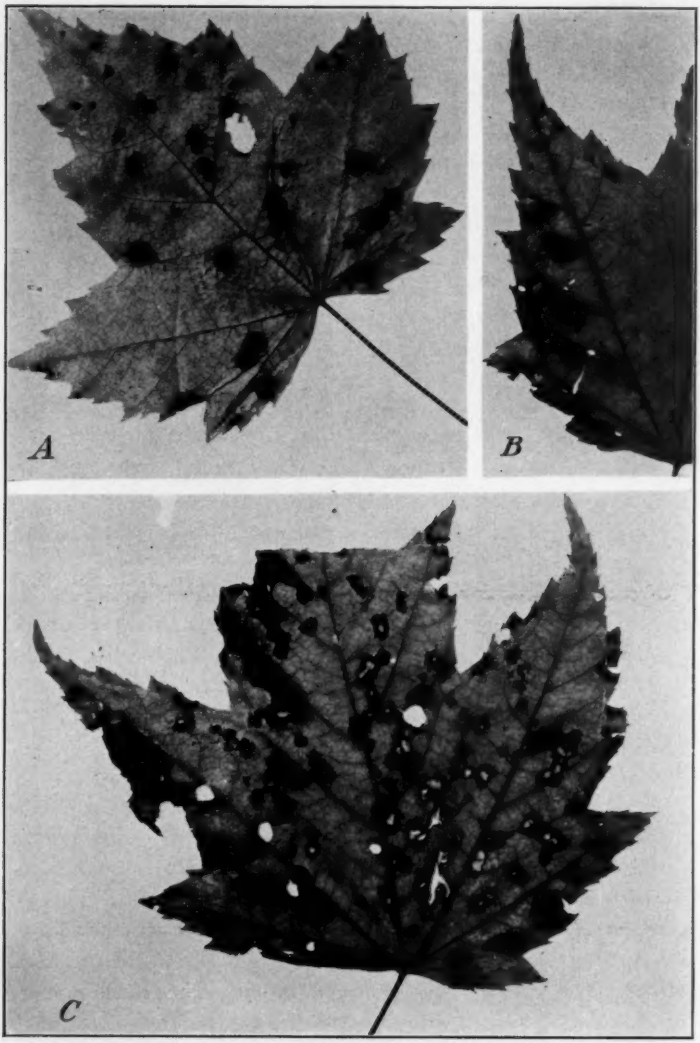


FIG. 2. *Taphrina Dearnessii* on *Acer rubrum* from vicinity of Ithaca, New York, (*A*) Ellis Hollow Road (Ray *351*) and (*B, C*) Ringwood Preserve (Ray *350*). Both collected on June 11, 1937. × 1. Photographs by M. L. F. Foubert.

of the same host in California. Thus *A. rubra* is an example of one host susceptible to three species of *Taphrina.* The female catkins of *A. tenuifolia* Nutt. and *A. rhombifolia* Nutt. may also

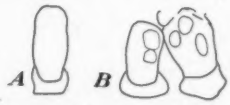


FIG. 3. Another comparison of asci of *Taphrina Dearnessii* from (*A*) *Ascer spicatum* and (*B*) *Acer rubrum:* × about 500.

be affected by *T. occidentalis.* Thus *T. occidentalis* is an example of a species capable of parasitism on three distinct forms of alder.

DISTRIBUTION OF TAPHRINA ON NORTH AMERICAN MAPLES

In addition to the present records of *Taphrina Dearnessii* from the vicinity of Ithaca, where the senior writer had collected it in 1927 (**4**), the junior writer has recently discovered the fungus on red maple in Oklahoma. Previously the fungus had not been

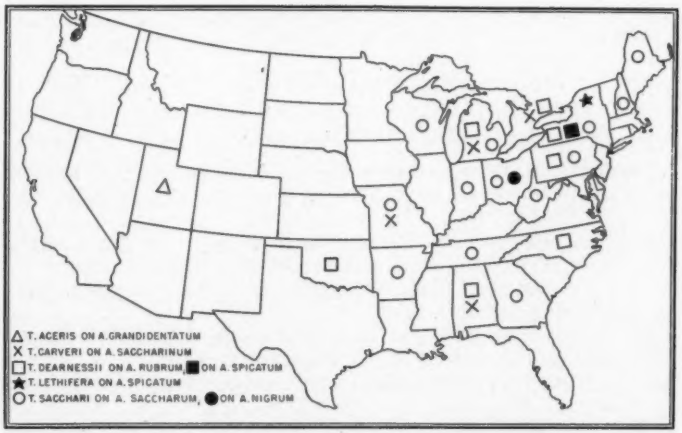


FIG. 4. Distribution of *Taphrina* in North America.

found west of the Mississippi River. Other westerly distribution records established during the past year for *Taphrina* species on maple are those of *T. Sacchari* in Wisconsin, based on a record of

1904 (3) and that of *T. Carveri* for Missouri based on a record of the current year (1939) (5). The known distribution of the group in North America is summarized on the map shown in figure 4.

SUMMARY

A species of *Taphrina* found on mountain maple in the vicinity of Ithaca, New York, in June 1937, is determined to be *T. Dearnessii* recently described on red maple from the United States and Canada. In the *Taphrina* group on North American maples, this is the second instance of one species infecting two different hosts, and the first of two species affecting the same host. The other species described on mountain maple is *T. lethifera* of which there is still only a single record from the Adirondack Mountains (1886). The first record of *T. Dearnessii* west of the Mississippi River, in Oklahoma, is given, and the present known distribution of the entire group is summarized on a map.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.
AND
OKLAHOMA AGRICULTURAL AND
MECHANICAL COLLEGE,
STILLWATER, OKLAHOMA

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NOTES AND BRIEF ARTICLES

Selenophoma on Grasses[1]

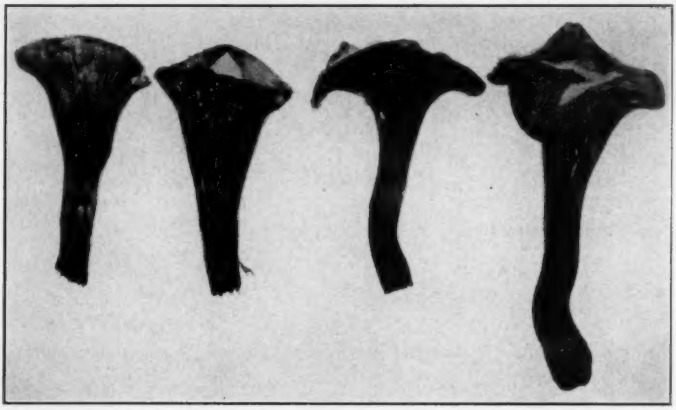
In connection with studies on *Septoria* spp. on Gramineae in the Pacific Northwest, it has been determined that certain fungi with nonseptate, falcate spores, borne in small globose pycnidia with coarse, globose peridial cells, were more logically assigned to *Selenophoma* Maire than to *Septoria* Fries. Accordingly, *Septoria bromigena* Sacc. on *Bromus inermis* becomes **Selenophoma bromigena** (Sacc.) comb. nov.; *Septoria donacis* Pass. on *Arundo donax* and other grasses becomes **Selenophoma donacis** (Pass.) comb. nov.—Roderick Sprague and A. G. Johnson.

Craterellus unicolor Berk & Rav. in Florida

The writer recently found this fungus in several different localities in central Florida and his notes may be of interest. The illustration, from a photograph kindly taken by Dr. G. F. Weber, is valuable because made from typical, fresh, well-developed sporophores. The species in question was originally described from specimens collected by Ravenel at Black Oak, S. C., in 1850 and distributed as *No. 1406*. According to Burt, the same fungus was found in Massachusetts by Dr. Francis and sent to Peck, who described it in 1899 as *Craterellus corrugis*. Coker in 1923 made both of these names synonyms of *Clavaria pistillaris* L.

On first seeing *C. unicolor* in the field, in Florida, the writer felt that he was looking at a new fungus; one quite different from the *C. pistillaris* he had so often collected in the northern states. When he examined the spores he found them to be, as Burt had said, much more slender than those of *C. pistillaris*. Young speci-

[1] Cooperative Investigations between the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, and the Oregon Agricultural Experiment Station. Published with the approval of the Director of the Oregon Experiment Station as Tech. Paper No. *332* Contribution from the Department of Botany.



Craterellus unicolor.

mens, to be sure, are difficult to distinguish but mature sporophores are usually much enlarged above, as shown in the accompanying illustrations. *C. unicolor* occurs in groups, usually in high-pine-turkey-oak woods, growing in patches of leaves. The soil is sandy and sterile, moist during rainy periods but often quite dry. Always there is shade but it is never very dense.—W. A. MURRILL.

A KEY TO AGARICS

A graphic, illustrated, radially-arranged key to the principal genera of the Agaricaceae of the United States has been prepared for use by mycologists or others who have had less technical training. The key and a brief glossary of the terms used in the key were printed by the offset method on sheets of paper that measure 25 × 19 inches. Single or several copies may be obtained without cost by writing to the Department of Botany, University of Missouri, Columbia, Missouri. Arrangements can be made for securing a greater number of copies.—JOHN B. ROUTIEN.

MYCOBIOTA OF NORTH AMERICA

(Mycobiota of Mount Shasta)

During the past three summers it has been my pleasure to live at timberline on Mount Shasta in northern California. During

this time I have collected a number of fungi, about 200 species, of which there was material enough in 75 collections for distribution in exsiccati form. Accordingly, during the past few months I have spent most of my time in preparing 25 sets of these fungi. The first 70 numbers of my first Century include these specimens and are now ready for distribution. Some of the specimens have been determined for me by various specialists. The specimens are accompanied by printed labels and are packeted in news-print since it is a low priced medium, and since many herbaria have their own standards in paper, size of packets, etc. A wide range of genera is represented. Several sets are still available. Further information may be had by writing the author.—WM. BRIDGE COOKE.

MYCOLOGICAL SOCIETY OF AMERICA

SUMMER FORAY

The 1940 Foray will be held in the Mt. Katahdin region of Maine, August 20th to 24th, inclusive, with the collaboration of the Department of Botany and Entomology of the University of Maine. Headquarters will be at the High School in Millinocket. A member of the Foray committee will be at the High School on Tuesday and Wednesday to give such assistance as may be desired.

Millinocket is 105 miles north of Bangor by U. S. Route 2 to Mattawamkeag, and Maine 157 from there on. From Boston, Bangor can be reached entirely by the shore road, U. S. Route 1. A somewhat shorter route with somewhat better roads can be followed by leaving Route 1 at Brunswick, Maine, and going north to Augusta on U. S. 201, and then taking one of the two alternative routes from Augusta to Bangor. Those coming from others parts of New England or from states west can strike the excellent U. S. Route 2 through the White Mountains at any desired place across Vermont, New Hampshire or southern Maine.

Accommodations will be available as follows:

Great Northern Hotel, Millinocket—rooms with bath, $2.50 a person; without bath, $1.50 a person; meals a la carte.
Tourist homes in Millinocket—$1.00 a person a night.

Kidney Pond or Bradeen Camps (new cabins), 30 miles northwest of Millinocket and 5 or 6 miles from Mt. Katahdin—$5.00 a person a day double, $30.00 a week ($6.00 a day single). Mrs. Laura Bradeen, Prop., Millinocket.

Togue Pond Camps (individual log cabins), 18 miles from Millinocket, 12 miles from the top of Mt. Katahdin—$4.50 a day, $28.00 a week. R. H. Crawford, Prop., Millinocket.

Yorks Camps at Daicey Pond, near the Kidney Pond Camps—no detailed information available, but probably of the same type, with rates similar to the preceding ones.

Chimney Pond in Baxter State Park, for those who wish to rough it, with water, fuel, cooking utensils and lean-to's available (but food and blankets not provided), about 25 miles from Millinocket and a little over 3 miles by trail from the end of the auto road.

Several other camps on lakes not directly accessible by auto.

Two restaurants in Millinocket.

The laboratories of the Millinocket High School have very graciously been placed at the disposal of the Society for the care and study of the fungi collected.

Further information concerning accommodations, fishing, mountain climbing, etc., can be obtained from the Chamber of Commerce in Millinocket; from Dr. F. H. Steinmetz, Department of Botany and Entomology, University of Maine, Orono, Maine; or from the chairman of the Committee at Brown University, Providence, R. I.

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